APPENDIX B

REPORTS ON THE SELECTION OF ALTERNATIVE SITES FOR THE SNS

This page intentionally left blank.

B. REPORTS ON THE SELECTION OF ALTERNATIVE SITES FOR THE SNS

This appendix includes the *National Spallation Neutron Source Project Alternate Site Selection Report,* prepared by the U.S. Department of Energy, Office of Energy Research, which explains the site selection process for the proposed Spallation Neutron Source (SNS) project. It identifies the four national laboratory sites resulting from the analysis, that represent reasonable alternatives for detailed analysis for site selection of the SNS. Each of the four laboratories, Oak Ridge National Laboratory, Los Alamos National Laboratory, Argonne National Laboratory, and Brookhaven National Laboratory, were tasked with conducting an analysis to identify alternate sites within their complex for the location of the proposed SNS. This appendix also includes the four reports submitted by the laboratories that address their site specific selection process.

This page intentionally left blank.

NATIONAL SPALLATION NEUTRON SOURCE
SITE SELECTION REPORT

This page intentionally left blank.

NATIONAL SPALLATION NEUTRON SOURCE PROJECT
ALTERNATE SITE SELECTION REPORT
Rev. 6

U.S. Department of Energy
Office of Energy Research

July, 1997

Table of Contents

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

ANL	Argonne National Laboratory
ANS	Advanced Neutron Source
BES	DOE Office of Basic Energy Science
BESAC	DOE Basic Energy Science Advisory Council
BNL	Brookhaven National Laboratory
CFR	U.S. Code of Federal Regulations
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
EIS	Environmental Impact Statement
ER	DOE Office of Energy Research
ES&H	Environment, Safety and Health
FEMA	Federal Emergency Management Agency
LANL	Los Alamos National Laboratory
NAS	National Academy of Science
NEPA	National Environmental Policy Act
NRHP	National Register of Historic Places
NSNS	National Spallation Neutron Source
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations

1.0 INTRODUCTION

Over the past 40 years, the use of neutrons for research purposes, a technology which was invented by the US at Oak Ridge National Laboratory (ORNL), has played an invaluable role in advancements in the fields of fundamental science, technology, and medicine. Neutrons provide critical investigative techniques to obtain information that is impossible to acquire by any other means. However, in the last 20 years, the U.S. has fallen behind the European scientific community in the availability of state-of-the-art neutron sources and instrumentation because of aging U.S. facilities, and because the European community has continually upgraded and added new neutron science facilities. Since the 1970's, numerous assessments have firmly established the need for new neutron sources and instrumentation in the U.S (NAS, 1984b).

Existing U.S. reactor-based neutron sources were built in the U.S. over 25 years ago. The existing spallation sources were built in the early 1980's and are based on aging accelerator facilities (DOE, 1993). These facilities have had minimal upgrading and modernization, and are not well suited to the specific areas of research to which scientific investigation has evolved. The need for a new neutron source has been recognized by every national panel investigating the status of neutron sources and science in the U.S. since the NAS study in 1977 (DOE, 1993; NAS, 1977). After reviewing the situation regarding all major domestic facilities for materials research, an NAS' panel (1984a) recommended:

1. Construction of a new high-flux, reactor-based neutron source, and;

2. Development of a plan leading to the construction of a major accelerator-based spallation neutron source.

These recommendations were reaffirmed in 1993 by the U.S. Department of Energy's (DOE) Basic Energy Science Advisory Committee (BESAC) Panel on "Neutron Sources for America's Future" (DOE, 1993). Although a reactor-based Advanced Neutron Source (ANS) Project was proposed in fiscal years 1994 and 1995, the project was not pursued in the fiscal

year 1996 budget process, primarily due to the high cost (about $3 billion) of the total project. However, the need for a viable new neutron source continues, and the emphasis has shifted to a lower cost option of the proposed accelerator-based National Spallation Neutron Source (NSNS) program. According to the March 10, 1996 BESAC advisory committee recommendations (Lineberger, 1996), "there is an urgent need to build a short pulsed spallation source in the 1 MW power range dedicated to neutron scattering with sufficient design flexibility such that it can be operated at a significantly higher power in a later stage."

Design and construction of the proposed NSNS Project is a major component of the DOE Office of Energy Research's (ER) efforts to meet these goals. Such a facility would allow for advanced research in the U.S. by producing a high flux of neutrons for experiments in the physical and biological sciences for industrial application and medical research. It would provide the U.S. with a facility that meets many of the long-term needs for neutron research by the scientific community over a wide-range of disciplines, and it would be available to government, educational, and industrial users.

In the 1996 "Energy and Water Development Appropriations Bill", Congress committed funding for DOE to pursue research, design and conceptual design activities for a spallation neutron source. The preferred alternative site for this spallation source was identified as Oak Ridge National Laboratory (ORNL), "... to maximize the use of the expertise already developed through preparation of the advanced neutron source design and to take advantage of the laboratory's experience in operating particle accelerators and conducting neutron scattering research...". (Congressional Record, 1995).

2.0 THE PROPOSED NSNS PROJECT ALTERNATE SITE SELECTION PROCESS

In 1995, DOE decided to move forward with a conceptual design for the proposed NSNS Project. Accordingly, DOE ER made the determination to prepare an EIS which led to a programmatic site selection process to logically identify suitable alternatives to the DOE's "preferred alternative" (ORNL) for the proposed NSNS Project. This process consisted of a tiered, or multi-phased approach, including:

1) Identification of the basic technical/logistical requirements or needs for meeting the NSNS Project mission goals;

2) Decision to limit potential NSNS Project sites to existing DOE facilities; and

3) Preliminary exclusionary screening of DOE alternate sites based on "fatal flaws".

2.1 Technical/Logistical Requirements

The initial task in the site-selection process involved the definition of specific project requirements. This information was used to develop the various levels of technical/logistic site exclusionary criteria.

For the NSNS Project, the following basic technical and logistical requirements are necessary to meet the mission goal of supporting neutron science research, and providing neutrons for materials research:

1) A minimum 110-acre site that has a rectilinear footprint to accommodate the length of the proposed linear accelerator and possible future expansion of the facility.

2) a one-mile buffer zone around the proposed NSNS Project facility site
   - to restrict uncontrolled public occupancy
   - to insulate the public from the consequences of a postulated accident at the facility.

3) availability of/proximity to source of adequate electric power
   - regional power grid able to supply 40 megawatts of power during periods of operation
   - within one-quarter to one mile of existing transmission lines to minimize collateral construction impacts and costs.

4) presence of existing neutron science programs to provide
   - a pool of existing neutron science expertise and experience to meet the mission goals
   - major, in-place facilities and programs utilizing neutron scattering techniques.

2.2 Use of Existing DOE Facilities

In assessing potential candidate sites in the U.S., the opportunities fall into three categories:

1) existing DOE sites;

2) DOE acquisition and development of other federal property, or a new, privately-owned site; or,

3) joint use of a non-federal site (i.e., an academic facility)

The DOE is the third largest land-owner within the federal government, behind the Department of Defense (DOD) and the Department of the Interior (DOI), and is responsible for the management and/or control of 2,367,818 acres nation-wide. Although not limiting from a geographical standpoint, this approach provides an estimated 2.37 million total acres and many

facilities nation-wide from which to select candidate sites (Nettle, 1996; DOE, 1996). This would include DOE Operations Offices, Site Offices, Power Administrations, and Special Purpose Offices that are not really suited to development of the proposed project, as explained later in this report. Several DOE facilities appear to meet all of the basic requirements necessary to meet the NSNS mission goal so the search within the DOE was limited primarily to facilities like national laboratories, which would likely have sufficient land holdings to accommodate the proposed project.

Other existing federal sites would include non-DOE sites such as DOD facilities (closed U.S. Air Force bases, for example), or lands managed by other federal agencies such as the DOI. The DOE could also acquire a new site that is presently privately-owned through purchase, trade or possible condemnation. Acquisition of these types of properties would require lengthy, costly, and more detailed site selection, environmental compliance, and jurisdictional transfer processes. In addition, while some of these types of candidate sites might offer some of the physical and power requirements needed to meet the NSNS Project mission goals, none of these types of sites can offer the neutron science and infrastructure support requirements. Finally, as the general public continues to express its concerns on limiting the growth of the federal government, it is unlikely that the public would support the acquisition or transfer of new lands from private or public use to simply duplicate facilities, resources, support structures, and uses available at existing DOE facilities.

A final candidate site category includes co-location of the NSNS facility at a non-federal location, such as an academic center or private research facility. This category was dropped from further consideration because, again, few if any of the non-DOE facilities can offer all of the required neutron science and infrastructure support requirements. Also, to establish a facility of the magnitude of the proposed NSNS Project would, in essence, create another national

laboratory-type facility. It would not maximize the use of existing federal and/or DOE resources, would not be cost efficient, and could duplicate existing DOE missions. This would be in direct conflict with current DOE initiatives, as defined in several recently released studies and reports (DOE, 1994; DOE,1995a; DOE, 1995).

It is therefore appropriate not only to limit the designated alternate site search to federal properties, but also to further limit the proposed site search to specific types of DOE facilities (i.e. national laboratories), only.

2.3 Exclusionary Screening of Alternate Sites

After the minimum technical and logistic requirements were identified and reviewed to determine the basic aspects of the project that are all required to meet the mission goals without incurring unacceptable costs, these factors were used to define "fatal flaw," ("go-no go") or preliminary exclusionary criteria. The four requirements carried forward as exclusionary or "fatal flaw" criteria included:

1) enough space for a 110-acre, rectilinear site footprint

2) a 1-mile buffer

3) power availability/proximity

4) existing neutron science capability

Of the major DOE facilities that are DOE-owned or -operated facilities, most were immediately eliminated from serious consideration due to the nature of the site or uniqueness of the programs carried out at the site. For example, DOE Operations Offices were excluded from the list of considered facilities because they are typically located in office buildings, in or near downtown population areas, and lack sufficient land to meet project objectives. The DOE Power

Administration Offices and most Special Project Offices are so specialized that they do not have the necessary program experience or the necessary infrastructure to support an NSNS Project-type of effort. Examples would include DOE facilities such as the Petroleum Reserves in California and Louisiana, and the Oilshale Reserves in Colorado and Wyoming.

Based on these preliminary DOE facility screening criteria, 39 DOE facilities were carried forward as the "universe" of potentially available sites. These sites are shown in Table 2.1, "NSNS Alternate Site Analysis Matrix."

After reviewing each DOE facility against the four "fatal flaw" exclusionary criteria, four national laboratory sites were carried forward to the next level of analysis. As stated above, a "no" response in any of the four criteria categories resulted in the elimination of the site from further consideration. As indicated in Table 2.1, the potential sites resulting from this analysis that represent the array of reasonable alternatives for detailed analysis in the EIS are:

- Argonne National Laboratory (East) (ANL); Argonne, Illinois
- Brookhaven National Laboratory (BNL); Upton, New York
- Los Alamos National Laboratory (LANL); Los Alamos, New Mexico
- Oak Ridge National Laboratory (ORNL); Oak Ridge, Tennessee

This information was then factored into the development of the alternatives to be considered in the EIS, including:

1) The Proposed Action: siting/construction/development of the proposed NSNS Project at a DOE facility

   a) The DOE's Preferred Alternative: siting/construction/development of the

   b) Other Potentially Acceptable Siting Alternative(s): ANL; BNL; LANL

2) The No Action Alternative: no new NSNS Project; maintain the "status quo"

3) Other Alternatives To Be Considered:
   - technological alternatives (reactors/accelerator technology)

3.0 CONCLUSIONS AND RECOMMENDATIONS

Through a series of meetings, culminating in a meeting on June 22, 1996, DOE ER, BES, and Oak Ridge Operations (ORO) developed a programmatic alternate site and site location identification and selection process to logically select a suitable site. This analysis yielded identification of the preferred site (ORNL) and alternate sites (ANL, LANL, and BNL) for further evaluation. Subsequently, on March 13, 1997, BNL requested to be withdrawn as a potential alternative for the NSNS project due to a number of environmental issues the Laboratory is facing on Long Island. However, it was determined that BNL had to be evaluated because it met the programmatic screening criteria.

It is recommended that these alternatives be carried forward for use in developing the NSNS Project EIS Implementation Plan and Notice of Intent, and ultimately, in the preparation of the NSNS Project EIS.

Table 2.1
National Spallation Neutron Source
Alternate Site Analysis Matrix

Department of Energy Facilities	*Selection Criteria No. 1:* 110-acre Rectilinear Site Footprint	*Selection Criteria No. 2:* 1-mile Buffer	*Selection Criteria No. 3:* 40 MW Power Availability/Accessability	*Selection Criteria No 4:* Existing Neutron Science Capability
Ames Laboratory; Ames, IA	Y	N	Y	N
Argonne National Laboratory (East); Argonne, IL	Y	Y	Y	Y
Argonne National Laboratory (West); Idaho Falls, ID	N	Y	Y	N
Battelle Columbus Laboratories; Columbus, OH	N	N	Y	N
Bettis Atomic Power Laboratory; West Mifflin, PA	(?)	(?)	(?)	N
Brookhaven National Laboratory; Upton, NY	Y	Y	Y	Y
Continuous Electron Beam Accelerator Facility; Newport News, VA	N	N	Y	N
Energy Technology Engineering Center; Canoga Park, CA	(?)	(?)	(?)	N
Environmental Measurements Lab; New York, NY	N	N	N	N
Fernald Environmental Management Facility, Fernald, OH	Y	Y	Y	N
Fermi National Accelerator Laboratory; Batavia, IL	Y	Y	Y	N
Hanford Site; Hanford, WA	Y	Y	Y	N
Idaho National Engineering Laborоratory; Idaho Falls, ID	Y	Y	Y	N
Inhalation Toxicology Research Institute; Kirtland AFB, NM	N	N	Y	N
Kansas City Plant; Kansas City, MO	N	N	Y	N
Lawrence Berkley National Laboratory, Berley, CA	Y	Y	Y	N
Lawrence Livermore National Laboratory; Livermore, CA	Y	Y	(?)	N
Los Alamos National Laboratory, Los Alamos, NM	Y	Y	Y	Y
Morgantown Energy Technology Center; Morgantown, WV	N	N	N	N
Mound Plant; Miamisburg, OH	N	N	N	N
National Renewable Energy Laboratory; Golden, CO	N	N	(?)	N

Table 2.1
National Spallation Neutron Source
Alternate Site Analysis Matrix

Selection Criteria \ Department of Energy Facilities	Nevada Test Site; Mercury, NV	K-25 Plant/Site, Oak Ridge, TN	Oak Ridge national Laboratory; Oak Ridge, TN	Y-12 Plant; Oak Ridge, TN	Pacific Northwest National Laboratory; Richland, WA	Paducah Gaseous Diffusion Plant; Paducah, KY	Pantex Plant; Amarillo, TX	Pinellas Plant; St. Petersburg, FL	Pittsburgh Energy Technology Center; Pitsburgh, PA	Portsmouth Gaseous Diffusion Plant; Piketo, OH	Princeton Plasma Physics Laboratory; Princeton, NJ	Rocky Flats Environmental Technology Site; Golden, CO	Sandia National Laboratory/California; Livermore, CA	Sandia National Laboratory/New Mexico; Albuquerque, NM	Savannah River Site; Aiken, SC	Stanford Linear Accelerator Center; Stanford, CA	Waste Isolation Pilot Plant; Carlsbad, NM	West Valley Demonstration Site; West Valley, NY
Selection Criteria No. 1: 110-acre Rectilinear Site Footprint	Y	N	Y	N	(?)	Y(?	Y	N	(?)	Y	N	N	N	Y	Y	N	Y	(?)
Selection Criteria No. 2: 1-mile Buffer	Y	Y	Y	Y	(?)	(?)	Y	N	(?)	Y	N	N	N	Y	Y	N	Y	(?)
Selection Criteria No. 3: 40 Mw Power Availability/Accessability	(?)	Y	Y	Y	Y	Y	(?)	Y	(?)	Y	Y	Y	Y	Y(?	Y	Y	(?)	(?)
Selection Criteria No 4: Existing Neutron Science Capability	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

DRAFT NSNS Project Alternate Site Selection Report

7/9/97

4.0 REFERENCES

Congressional Record, 1995. 104th Congress, "Energy and Water Development Appropriations Bill, 1996." Report No, 104-149.

DOE, 1993. "Neutron Sources for America's Future: Report of the Basic Energy Sciences Advisory Committee Panel on Neutron Sources." Dr. Walter Kohn, Chair. U.S. Department of Energy Office of Energy Research. January, 1993.

DOE, 1994. "U.S. Department of Energy Strategic Plan." Washington, D.C. April, 1994

DOE, 1995a. "Alternative Futures for the Department of Energy National Laboratories.". Prepared by the Secretary of Energy Advisory Board, Task Force on Alternative Futures for the Department of Energy National Laboratories, Robert Galvin, Chairman. February, 1995

DOE, 1995b. "Energy R&D: Shaping our Nations Future in a Competitive World: Final Report of the Task Force on Strategic Energy Research and Development." Prepared by the U.S. Department of Energy Secretary of Energy Advisory Board Task Force on Strategic Energy Research and Development, Daniel Yergin, Chairman. June, 1995.

DOE, 1996. "ES&H Site Profiles." U.S. DOE Office of Oversight, Environment, Safety and Health. June, 1996

Krebs, M.A., 1995. Director, U.S. DOE Office of Energy Research, letter to Dr. Thomas Russell, Senior Scientist, Almaden Research Center, K91-802, IBM Research Laboratories, San Jose, CA. November 9, 1995.

Lineberger, W.C., 1996. Chair, U.S. DOE Basic Energy Sciences Advisory Council, letter to Dr. Martha Krebs, Director, U.S. DOE Office of Energy Research, Washington, D.C. March 10, 1996.

NAS, 1977. NRC Solid State Sciences Committee, "Neutron Research on Condensed Matter: A Study of the Facilities and Scientific Opportunities in the United States." National Academy of Sciences, Washington, D.C., 1977.

NAS, 1984a. "Major Facilities for Materials Research and Related Disciplines: Presentations to the Major Facilities Committee." Major Materials Facilities Committee, Commission on Physical Science, Mathematics, and the Resources National Research Council. Dean E. Eastman and Frederick Seitz, Co-chairs. National Academy Press, Washington, D.C., 1984.

NAS, 1984b. "Current Status of Neutron-scattering Research and Facilities in the United States." Panel on Neutron Scattering, Solid State Sciences Committee, Board on Physics and Astronomy, Commission on Physical Sciences, Mathematics and Resources, and the National Research Council. John J. Rush, Chair. National Academy Press, Washington, D.C., 1984.

Nettles, J.J. Jr., 1996a. Director, U.S. DOE Office of Emergency Management/Office of Nonproliferation and National Security, Washington, D.C., memorandum-for-distribution regarding, "Monthly Update of the DOE HQ Emergency Operations Notifications Call List and Facility List." April, 1996.

This page intentionally left blank.

OAK RIDGE NATIONAL LABORATORY
SITE SELECTION REPORT

This page intentionally left blank.

SPALLATION NEUTRON SOURCE
OAK RIDGE NATIONAL LABORATORY
SITE SELECTION REPORT

Prepared for the
United States Department of Energy/
Oak Ridge Operations Office

October 1998

This page intentionally left blank.

1.0 INTRODUCTION

In 1996, Congress provided funding for the Department of Energy (DOE) to pursue the development of a short-pulsed spallation neutron source. DOE identified the Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee, as the preferred site for the Spallation Neutron Source (SNS) facility (*1996 Energy and Water Development Appropriations Bill*). The three alternative locations considered for the facility were Los Alamos National Laboratory (LANL), Argonne National Laboratory (ANL), and Brookhaven National Laboratory (BNL).

The conventional facilities design team for the SNS project was tasked to identify candidate sites for the SNS on the Oak Ridge Reservation (ORR) and designate one of these sites as the preferred location through a comparative evaluation of the candidate sites. The conventional facilities design team developed a list of siting criteria that represented the physical and sociological requirements for the facility and included functional, environmental, programmatic, health and safety, and safeguards and security criteria.

The process for selecting a site for the SNS facility on the ORR has evolved over a two-year period. The purpose of this report is to provide information used in the evaluation of potential sites and to outline the decision-making process for siting the SNS on the ORR. The site identified as the preferred site on the ORR for the SNS will be compared with potential sites at LANL, ANL, and BNL in an Environmental Impact Statement (EIS).

2.0 ORR SITE SCREENING

With the establishment of definitive criteria, the SNS project contracted with the Site and Facilities Planning (SFP) Group of Lockheed Martin Energy Systems to perform a comprehensive screening of all areas on the ORR that should be considered for placement of the SNS. The SFP Group was the organization responsible for development planning on the entire reservation. As such, SFP developed and maintained technical site information, primarily electronic maps, addressing all of the five categories of criteria developed for the SNS by the project team. The three required criteria, functional, environmental, and health and safety were mapped electronically by SFP to screen the entire ORR and rule out those areas that clearly did not meet the project requirements. These were defined as areas that should not be carried forward for evaluation of specific site characteristics. These areas were essentially "fatal flaw" areas that would preclude development of the project as currently defined because of conservation, waste management, or other land use/environmental issues.

An Intergraph MGE Geographic Information System (GIS) overlay map was created using the most current information and a report entitled, *"Candidate Site Identification for the National Spallation Neutron Source Facility,"* was prepared by SFP and issued in August 1996. Table 1 lists the data sets used for the GIS analysis, along with the information sources that were used for the most current data that was mapped. Figure 1 is the map that was included in this report; the white areas are those that could be considered as candidate areas. Because of the general nature of overall ORR mapping information, minimal data sets were input. For example, the GIS recognizes contingent areas but cannot evaluate configurations such as the hammerhead shape of the SNS. Although steep slopes may not be desirable over large areas, a confined area of steep slope within the facility footprint could be tolerated if properly configured. Therefore, these areas were not excluded from consideration at this point.

Table 1. SNS Candidate Site Identification Data Sets

Data Set	Information Source
Conservation Issues	
Natural/aquatic/reference areas, sinkholes, and a 200-foot buffer	Pat Parr, Environmental Sciences Division, ORNL
BSR2 areas and a 200-foot buffer	The Nature Conservancy, Primary Conservation Sites map (5/24/95)
Wetlands and a 200-foot buffer	Pat Parr, Environmental Sciences Division, ORNL
Environmental sciences research sites	Pat Parr, Environmental Sciences Division, ORNL
Waste Management Issues	
Waste area groupings	Nonradioactive Storage Area (NRSA)
Source control operable units (Environmental Restoration projects)	NRSA
Waste management areas	ORR Technical Site Information (MMES 1994)
Other Issues	
Historic/cultural/archaeological resources and a 200-foot buffer	Peter Souza, Office of Environmental Compliance and Documentation, ORNL
Existing structures and a 1640-foot buffer	Tennessee Valley Authority (TVA), Oak Ridge Area S-16A quadrangle map, 1994 ORR SDP/TSI updated information
Surface hydrology and a 50-foot buffer	TVA, Oak Ridge Area S-16A quadrangle map
500-year floodplains	Richard Durfee, Geographic Information Science and Technology Group, ORNL
Primary roadways and a 100-foot buffer	TVA Oak Ridge Area S-16A quadrangle map

Source: LMES 1996.

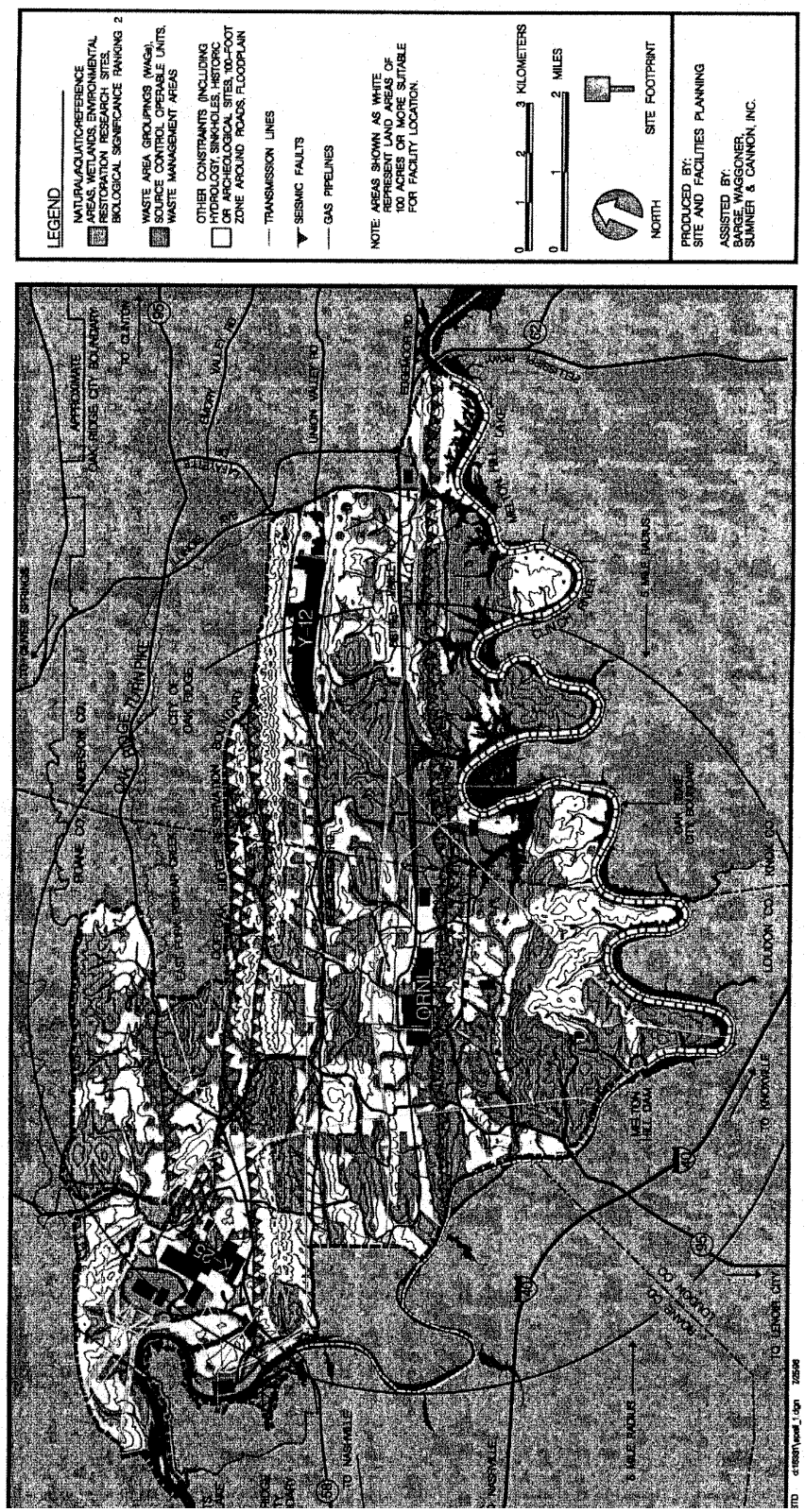


Figure 1. Spallation Neutron Source Candidate Site Map (LMES 1996).

Two other maps were included in the GIS report, one indicating Environmental Restoration watershed projects and the other indicating the current National Environmental Research Park boundaries and the proposed expansion of those boundaries to encompass virtually the entire ORR, except for the existing three plant sites. These maps were included in the GIS report as informational data only and are shown in Figures 2 and 3.

An augmented analysis was then made of the screened areas identified in the report. Using the SNS footprint criteria, general size, shape, and terrain, the ORNL site selection team identified four candidate site areas that exhibited the most favorable characteristics. A fifth area, the previously developed Clinch River Breeder Reactor (CRBR) site, was added by the SNS project even though the mapped data were not available for the GIS analysis. This site had previously been favored and studied in detail, but the property was not owned by the DOE. Figure 4 identifies the five sites selected for further evaluation.

These candidate sites include: Alternative 1 - the area south of the High Flux Isotope Reactor (HFIR); Alternative 2 - the area east of the Health Physics Research Reactor (HPRR); Alternative 3 - Freels Bend; Alternative 4 - the Chestnut Ridge site; and the CRBR site to be revisited.

3.0 CANDIDATE SITE EVALUATION

Using the original SNS general requirements, the selection team grouped the various criteria into five topical groups. These five topical groups were derived from the original requirements to be more site specific than the general criteria and provided more detailed and consistent criteria for the second phase of the evaluation. The SNS footprint was superimposed on each candidate site area and each was evaluated using the following criteria:

- **Constructibility.** The suitability of a given site to meet specified conditions for construction of the facility without exorbitant cost or effect on the environment. Here, steep slopes within the construction boundary were evaluated accordingly to the positive and/or negative impacts they may have on construction. The bulk of the original criteria fall in this group, therefore, these criteria are the most important. The key considerations under this category are:

    - site gradient and how the site contour conforms to the SNS footprint
    - utility access
    - primary and secondary road access
    - soils suitability and seismicity
    - overlapping and adjacent environmental areas such as nature areas or biological significance rated (BSR) areas
    - presence and proximity to contaminated sites
    - land use/ownership
    - security notification zones
    - distance to aquifers

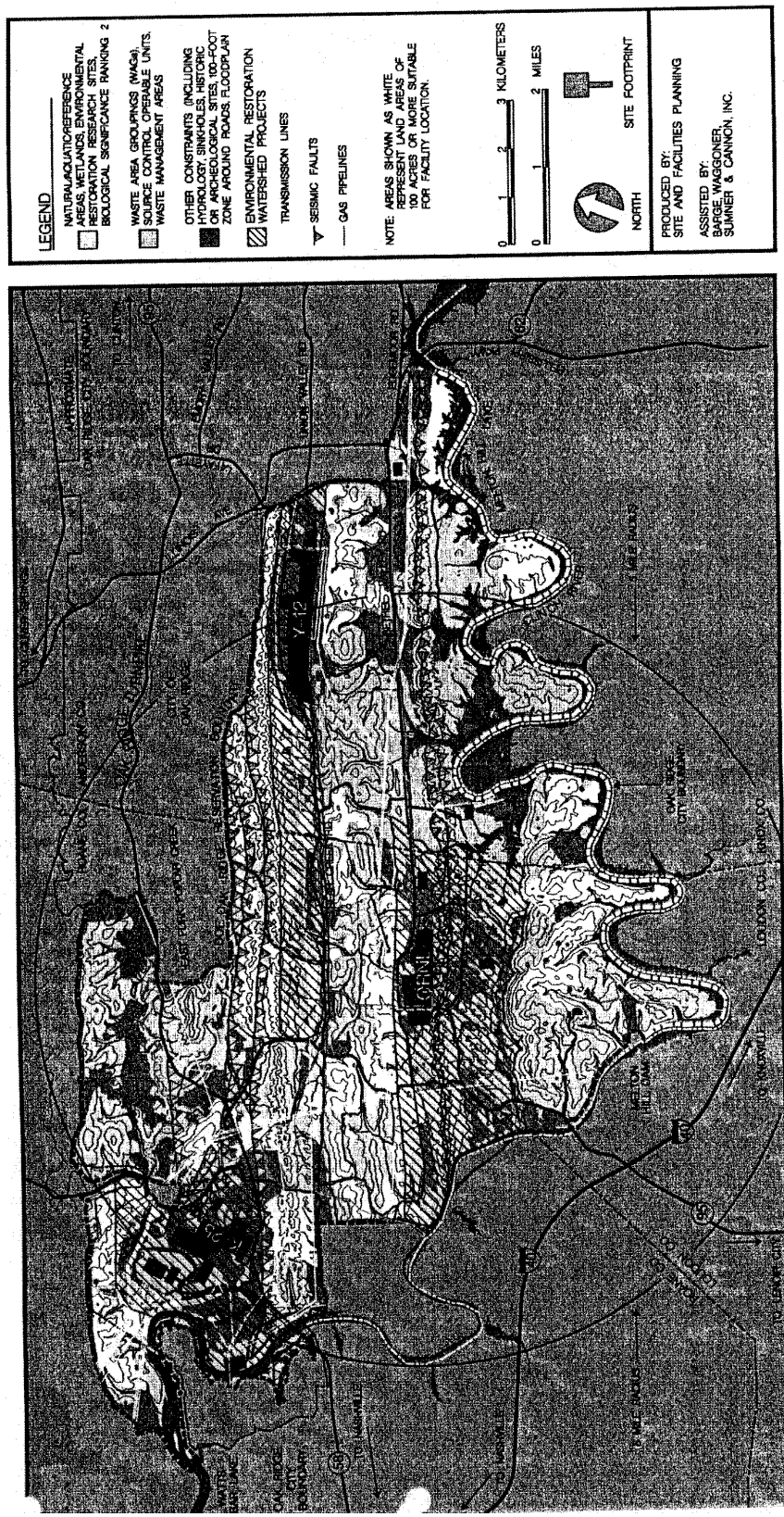


Figure 2. Spallation Neutron Source Candidate Site Map with Environmental Watershed Projects (LMES 1996).

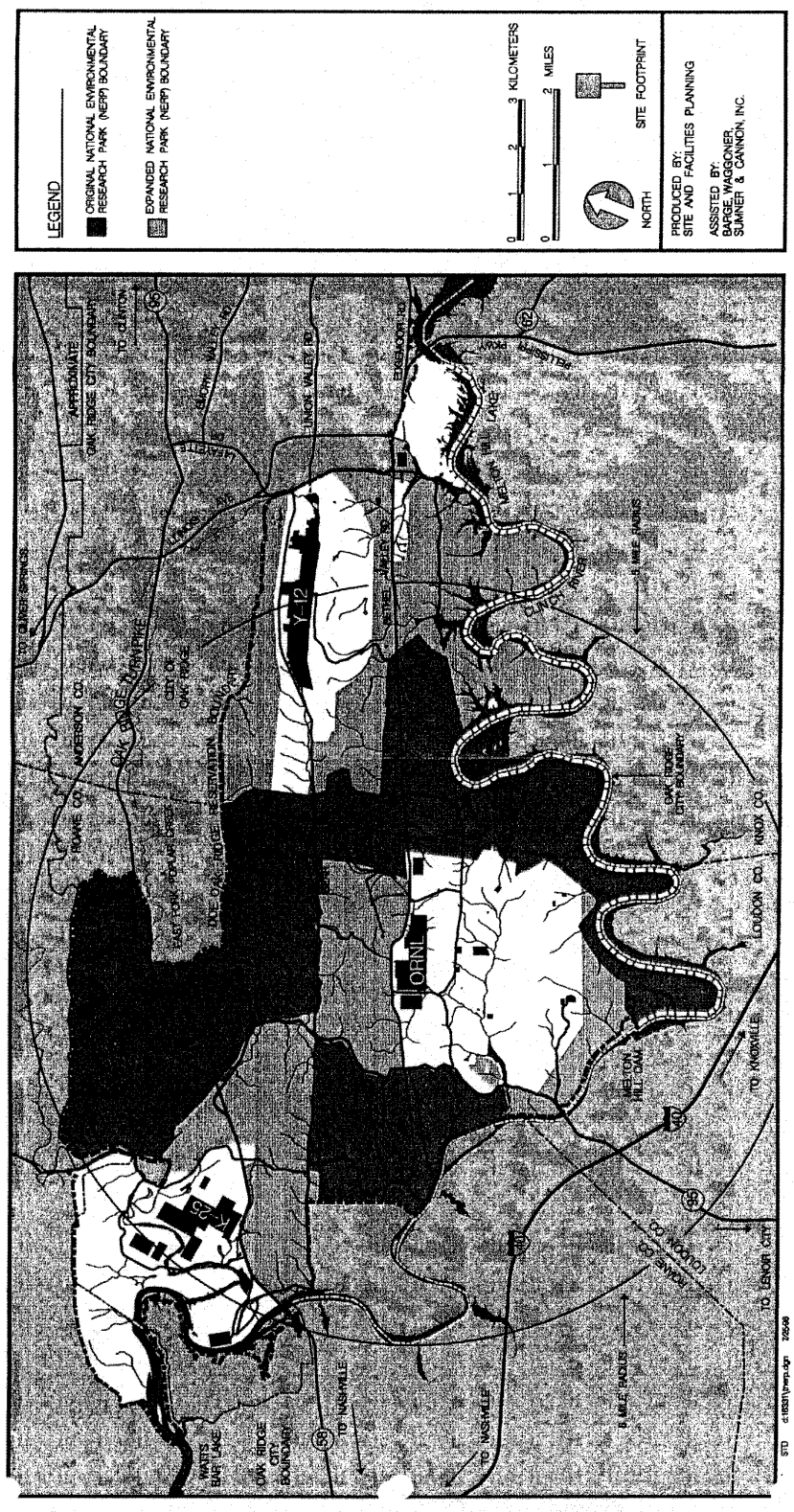


Figure 3. National Environmental Research Park (LMES 1996).

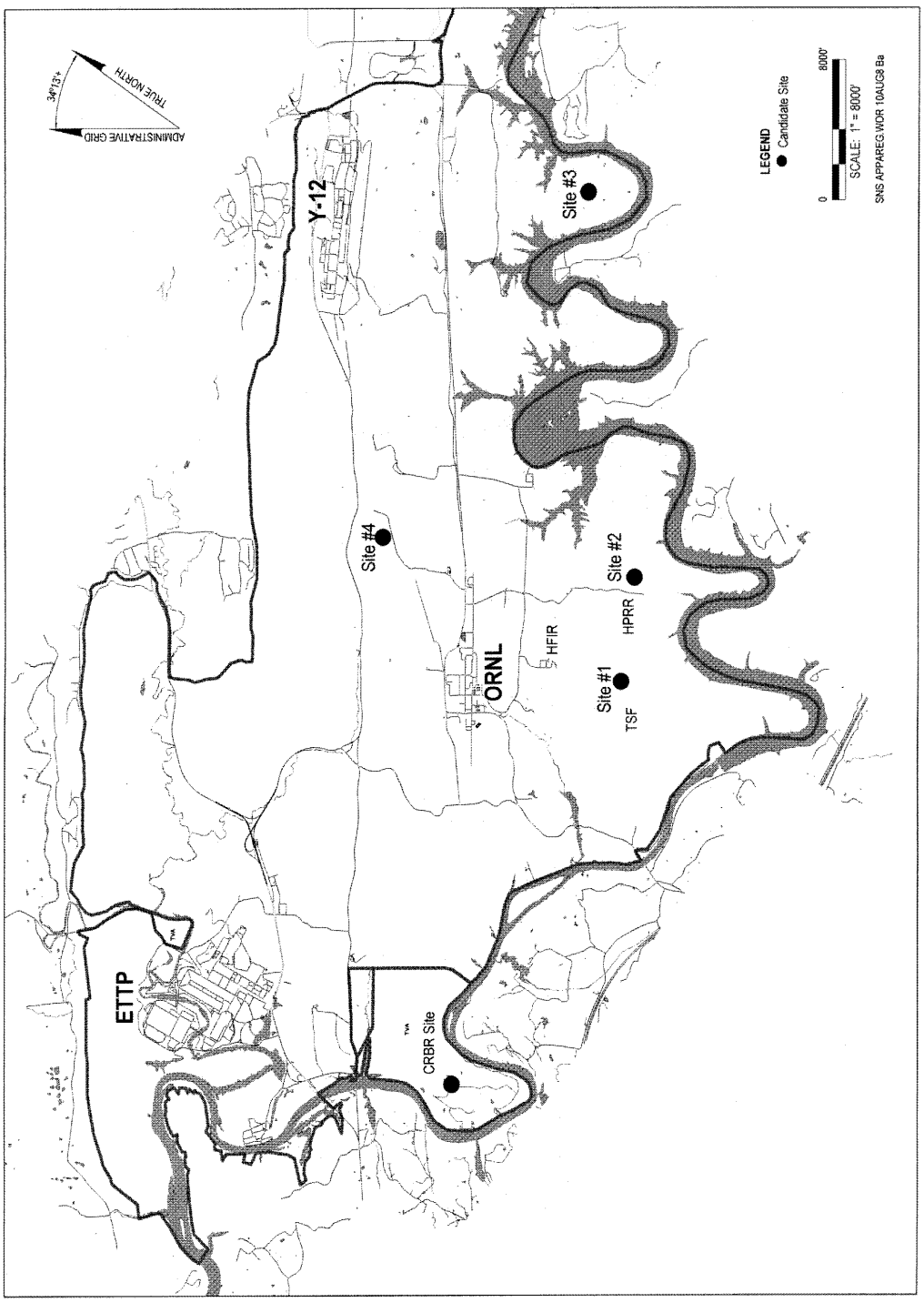


Figure 4. Location of Candidate ORNL Area Sites.

- **Flood Potential.** The likelihood of the site being affected by flooding, given that these areas are not within the 500-year flood plain, but could be adversely affected by localized flooding.

- **Proximity of Occupied Buildings/Areas.** An original criterion required a 500-meter buffer from occupied buildings. The relative closeness to permanent residential areas in comparison to the other candidate sites was considered.

- **Proximity to Historic Resources.** The relative closeness of historic resources considered limited and nonrenewable because of their association with historic events, persons, or social or historic movements. The impact that site grading may have on these sites beyond the actual SNS footprint was compared among sites.

- **Distance from ORNL/HFIR.** The GIS map indicated an approximate 5-minute-travel-distance circle as a preferable criterion. The relative proximity of each site was evaluated against the other sites.

These criteria were used for the comparative evaluation of the potential sites. Where candidate areas offered more than one potential site, only the prime site was carried forward. Desirable criteria, as well as required criteria, were considered. Table 2 presents the summary evaluation of the five potential candidate sites according to the aforementioned site-specific siting criteria. Summary descriptions of the five sites are presented below:

Area South of HFIR (Alternative 1). This site meets three of the five specific criteria groups. The site is not in danger of flooding, it is extremely close to ORNL/HFIR, and it is not in close proximity to occupied areas. However, two of the main criteria, constructibility and proximity to historic sites, were not met. The site has slopes of greater than 25 percent in areas that would not conform to the SNS footprint requirements. Much of the area is classified as fragile land, land defined in the technical site information document as best reserved for natural areas and not suitable for construction. Only electric utilities are nearby and road access is poor at best. Several areas within close proximity to this site have historical value, and the site is completely within a Biodiversity Significance Ranking (BSR) 2 area, the significance area ranked highest on the ORR by the Nature Conservancy (no BSR1 areas are present on the ORR). Use of the Alternative 1 site would involve additional expense to extend adequate utilities, improve road access, conduct assessments of historic areas, and perform grading to provide an adequately sized pad and overall site for the SNS facility.

Area East of HPRR (Alternative 2). This site also meets three of the five specific criteria groups. The site is not in danger of flooding, it is extremely close to ORNL/HFIR, and it is not in close proximity to occupied areas. The remaining two are not met, however, because this site also has slopes of greater than 25 percent in areas that would not conform to the SNS footprint requirements. Much of the area is classified as fragile land. Only electric utilities are nearby, and road access is poor. Several areas within close proximity to this site are classified as historical sites. This site, which is similar in characteristics to Alternative 1, would require additional expense to extend adequate utilities, improve road access, conduct assessments of historic areas, and perform grading to provide an adequately sized pad and overall site for the SNS facility.

Freels Bend Site (Alternative 3). This site does not meet any of the five key, site-specific criteria used in this phase of the evaluation. It has poor constructibility because there are no major utilities close by and road access is poor. It lies outside the 5-minute arc on the GIS map and could potentially be blocked

Table 2. Evaluation of Siting Criteria at Five Candidate ORNL Area Sites.

GENERAL CRITERIA	SPECIFIC CRITERIA	SITE CHARACTERISTICS				
		ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	CRBR SITE
Functional Criteria	**Constructibility**	Slopes >25%	Slopes >25%	Slopes >25%	Slopes <25%	Slopes <25%
	Constructibility	Knox Group/Knox Residuum soil	Knox Group/Knox Residuum soil	Knox Group/Knox Residuum soil	Knox Group/Knox Residuum soil	Knox Group/Knox Residuum soil
	Constructibility	Pleistocene alluvium	Pleistocene alluvium	Pleistocene alluvium	Holocene/recent alluvial	
	Constructibility	Fragile land classification	Fragile land classification	No classification	No classification	No classification
	Constructibility	Limited utilities (electric only)	Limited utilities (electric only)	Limited utilities (gas and electric only)	Close proximity/access to utilities (gas, electric, water)	Close proximity to utilities (gas, electric, water)
	Distance from ORNL/HFIR	Close proximity to ORNL/HFIR	Close proximity to ORNL/HFIR	Not within close proximity to ORNL/HFIR	Close proximity to ORNL/HFIR	Not within close proximity to ORNL/HFIR
	Constructibility	Poor proximity to primary and/or secondary paved roads	Poor proximity to primary and/or secondary paved roads	Poor proximity to primary and/or secondary paved roads	Good proximity to primary and/or secondary paved roads	Good proximity to primary and/or secondary paved roads
Environmental Criteria	**Constructibility**	Completely within BSR2 Area	Within BSR3 Area	Close proximity to BSR3-7 and BSR3-13 areas	Within BSR3-16 area; Close proximity to BSR2-10	Within BSR2 area
	Constructibility	Close proximity to a contaminated site	Close proximity to a contaminated site	Close proximity to a contaminated site	Not in close proximity to a contaminated site	Relatively close proximity to a contaminated site
	Historic Site Proximity	Close proximity to historic sites	Close proximity to historic sites	Within and in close proximity to historic sites	Not in close proximity to historic sites	Not in close proximity to historic sites
	Constructibility	Knox Aquifer at surface	Knox Aquifer at surface	Knox Aquifer at surface	Knox Aquifer at surface	Knox Aquifer at surface
Safeguards & Security Criteria	**Constructibility**	Within security administration zone (controlled area)	Within security administration zone (controlled area)	Within security administration zone (Y-12 229 area)	Within security administration zone (restricted area)	Within security administration zone (restricted area)

Table 2. Evaluation of Siting Criteria at Five Candidate ORNL Area Sites (continued).

GENERAL CRITERIA	SPECIFIC CRITERIA	SITE CHARACTERISTICS				
		ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	CRBR SITE
Safeguards & Security Criteria (continued)	**Constructibility**	Within immediate notification zone	Within immediate notification zone	Not within immediate notification zone	Within immediate notification zone	Within immediate notification zone
	Constructibility	Within 5-mile emergency planning sector	Within 5-mile emergency planning sector	Within 5-mile emergency planning sector	Within 5-mile emergency planning sector	Within 5-mile emergency planning sector
	Constructibility	Within 2-mile public immediate notification zone	Within 2-mile public immediate notification zone	Outside 2-mile public immediate notification zone	Within 2-mile public immediate notification zone	Within 2-mile public immediate notification zone
Programmatic Criteria	**Constructibility**	Existing land use is natural area	Existing land use is natural area	Existing land use is natural area	Existing land use is multipurpose research and development area	Existing land use is industrial
	Constructibility	Site owned by DOE	Site owned by DOE	Site owned by DOE; Recent land request from City - parcel identified as self-sufficiency parcel	Site owned by DOE	Site owned by TVA
Health & Safety Criteria	**Constructibility**	No geological faults within area	No geological faults within area	No geological faults within area	No geological faults within area	No geological faults within area
	Flood Potential	No flood danger	No flood danger	Probable maximum flood area	No flood danger	No flood danger
	Residential Proximity	Not in close proximity to residential area	Not in close proximity to residential area	Close proximity to residential area	Not in close proximity to residential area	Close proximity to residential area

off in a probable maximum flood event. Freels Bend is just across the river from a lakefront residential district and has many historic sites indicated by mapping data.

Chestnut Ridge Site (Alternative 4). This site meets or exceeds all of the five topical criteria groups. The constructibility of the site is good because the site offers all required utilities close by. The lay of the land, although containing slopes greater than 25 percent, meets SNS footprint criteria with reasonable grading. Chestnut Ridge Road currently crosses the site and ties to Bethel Valley as well as Bear Creek Roads. The site is not in danger of floods, is not close to any occupied structures or residential areas, is close to ORNL and HFIR, and encroaches on no historic sites. In addition, the existing land use characterization of this site is multipurpose research and development.

Clinch River Breeder Reactor (CRBR) Site. This site meets three of the five key evaluation criteria. The constructibility of the site is favorable because of the low slopes. It has close access to gas, water, and electricity. Road access via existing roads is good. No flood danger is associated with the site. No historic sites are located in the way of construction. However, the proposed site is not in close proximity to HFIR and lies across the river from a residential area, which is closer than such areas are to three of the other sites. Most importantly, although this site was considered as an alternative with favorable conditions for siting the SNS, DOE does not own it. Acquisition of the property from TVA would increase the time for development of the SNS by an unknown amount.

The results of the comparative evaluation of candidate sites against the siting criteria, and more specifically the five key criteria, show that the Chestnut Ridge site (Alternative 4) offers the best overall potential of the five alternative sites reviewed by the SNS site selection team. Maps with site-specific criteria used during these evaluations are included in Exhibit 1.

4.0 RECOMMENDATION OF THE PREFERRED SITE

The SNS Project Group presented a preliminary summary of the candidate site evaluation process and its results to the Reservation Management Organization (RMO) for the ORR in late 1996. During this presentation, the Chestnut Ridge site (Alternative 4) was first identified as the preferred site for the SNS. All SNS design layouts and estimates for land improvements were to be based on this site.

A more thorough presentation of the candidate site evaluation process was delivered at an RMO meeting on April 3, 1997. During this presentation, the SNS Project Group formally designated the Chestnut Ridge site as its preferred location for the SNS at ORNL. This preference was based on the results of the candidate site evaluation process. Furthermore, the SNS Project Group requested that the RMO formally recommend this site to the Federal Property Management Committee as the preferred site for construction of the SNS.

The RMO reviewed the content of this presentation and issued review comments on June 25, 1997. These comments focused primarily on environmental concerns associated with siting the SNS on the Chestnut Ridge site and at Alternatives 1, 2, and 3. The concerns with the Chestnut Ridge site included karst topography and hydrologic transport related to this topography. They also included potential impacts of the SNS on White Oak Creek and research efforts in the nearby Walker Branch Watershed (WBW). The WBW research is being conducted by the National Oceanic and Atmospheric Administration/Atmospheric Turbulence and Diffusion Division (NOAA/ATDD) and the Environmental Sciences Division (ESD) at ORNL. In addition, the comments included a recommendation to consider use of the CRBR site for the SNS. The complete comments are presented in Exhibit 2.

A key SNS Project Group representative met with the RMO on August 7, 1997, to address the environmental and alternative siting issues raised in the review comments. Two major issues regarding the Chestnut Ridge site were addressed, (1) karst topography, and (2) potential adverse impacts on environmental science research in the WBW area. In close consultation with the RMO members, resolutions to these issues were mutually agreed to by the SNS Project Group and the RMO. The karst topography proved not to be an issue since large structures have been successfully built on karst topography, such as most of Knoxville proper, including the University of Tennessee. Experts in this area are currently on board and will continue to be involved in the SNS siting process to ensure that karst topography does not impact the initial construction of the SNS nor create any environmental concerns (i.e., hydrologic transport) after construction of the facility. The SNS Project Group responded to the issue concerning the WBW by acknowledging it was aware of the potential effect construction of the SNS could have on the WBW. Every possible action will be taken to minimize effects on this area. Based on these resolutions, the RMO formally recommended the Chestnut Ridge site as the preferred location for the SNS on August 15, 1997. In making this recommendation, the RMO cited four reasons why it considered the Chestnut Ridge site to be the "best site" for the SNS:

- Cost-effectiveness, based on several factors (near existing roads, utilities, and construction borrow areas; best situation for waste transport and use of ORNL shops, security, and facilities; and most advantageous topographical configuration for site excavation and construction of berm shielding).

- Least potential impact on the environment and public, because the site avoids wetlands, blue line streams, historical sites, threatened and/or endangered species, and other environmental impacts as well or better than the alternative sites. It is the most remote of the evaluated sites from public access areas.

- Best location for supporting ORNL neutron science programs.

- Located in close proximity to the preferred site for the Joint Institute for Neutron Sciences (JINS). This proposed facility would support neutron science programs at ORNL, HFIR, and the SNS.

The resolutions of the issues raised in the review comments on the site evaluation process are documented by the memorandum in Exhibit 3. The formal recommendation of the Chestnut Ridge site as the preferred site for the SNS at ORNL is also contained in this memorandum.

5.0 REFERENCES

LMES (Lockheed Martin Energy Systems, Inc.), 1996, *Candidate Site Identification for the National Spallation Neutron Source Facility*, ES/EN/SFP-47, August, prepared for the Department of Energy, Oak Ridge Operations, Oak Ridge, Tennessee.

MMES (Martin Marietta Energy Systems, Inc.), 1994, *Oak Ridge Reservation Technical Site Information*, ES/EN/SFP-23, August, prepared for the Department of Energy, Oak Ridge Operations, Oak Ridge, Tennessee.

EXHIBIT 1

SPALLATION NEUTRON SOURCE SITE EVALUATION CRITERIA AND CANDIDATE SITES

SPALLATION NEUTRON SOURCE SITE EVALUATION CRITERIA

Functional Criteria - These criteria relate to the physical parameters of the site, including the transportation and utility systems required for construction and operation.

- Site area requirement: 500 meters × 500 meters (1640 feet × 1640 feet) with a 100 meter × 500 meter (328 × 1640 feet) tail centered on the main square (hammer-head-shaped), all at the same elevation after excavation and preferably founded on solid rock. However, karst formations are not to be eliminated.

- Must have a stable foundation (capable of supporting 15,000 lbs/ft^2) that permits beam alignment along the entire beam line path.

- Must have an adjacent area, which can be at different elevations, measuring 100,000 square meters (24.7 acres) for support facilities, roads, buffer, etc.

- Reasonable proximity to a borrow area capable of supplying sufficient fill material for earthen shielding and a spoils area for storage or disposal of excess excavation material.

- Close proximity to ORNL (within 5 road minutes of ORNL proper)/HFIR.

- Avoid contaminated soils.

- Avoid relocating significant overhead and underground utilities (e.g., power lines, water line mains, and gas transmission lines).

- Minimize surface water runoff to or through the site.

- Proximity/access to existing utility systems:
  - 30 MW power required
  - Potable water required
  - Compressed air, natural gas, sanitary sewer, steam, and chilled water desirable but can be provided by on-site facilities
  - Availability of construction power within one mile strongly desirable

- Proximity to primary and/or secondary paved roads for users, researchers, materials, supplies; target transport; and waste and irradiated material removal.

Environmental Criteria - These criteria are used to minimize the effect of a site's development on the environment.

- Avoid disturbance of wetlands and streams.

- Avoid locations with a high significance ranking of threatened or endangered animal or plant species, specifically BSR 1 and 2 areas. (The Nature Conservancy BSRs are from a high of 1 for outstanding significance to a low of 5 for general biodiversity interest. BSR 1 and 2 areas are more critical and have a higher priority than BSR 3, 4, and 5 areas.)

- Avoid historic, cultural, or archaeological resources.

- Minimize impacts on natural reference and natural research areas in the National Environmental Research Park.

Safeguards and Security Criteria - These criteria relate to the ability of the site to provide physical safeguarding and security of the facility.

- Site maximizes use of existing physical security systems.

- Site maximizes use of existing programmatic security systems.

Programmatic Criteria - These criteria are used to ensure that the site considers appropriate site development and land use plans.

- Site maximizes use of existing land use areas.

- Site conforms to site development plans.

Health and Safety Criteria - These criteria provide a basis for candidate site selection in terms of protecting the public, facility personnel, and the facility from hazards during both construction and operation of the facility.

- Site construction and operation should minimize adverse impacts on traffic flow and traffic hazards adjacent to the site.

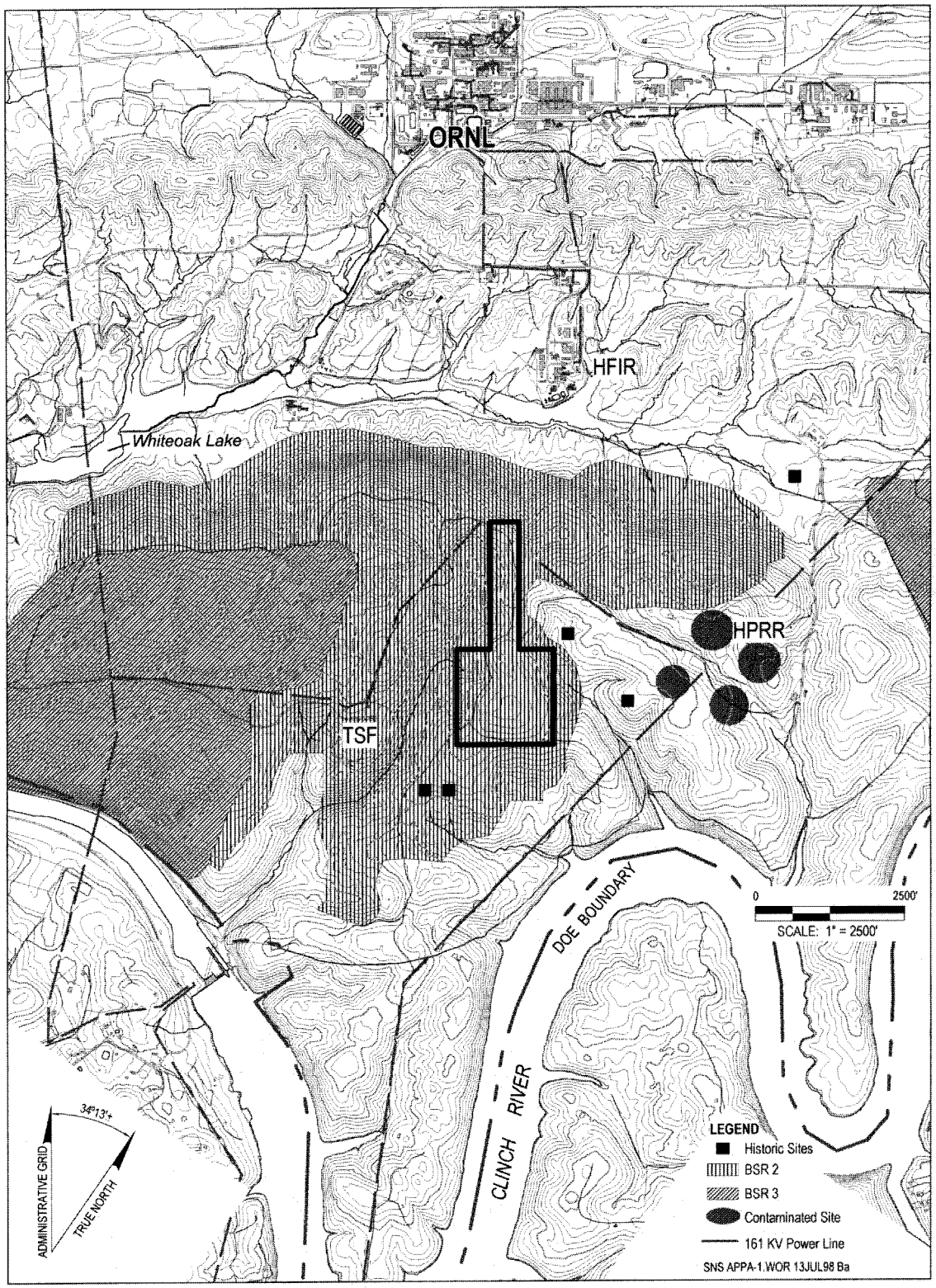
- Site should minimize adverse impacts on existing streams and groundwater.

- Site must not be located within the 500-year floodplain elevation.

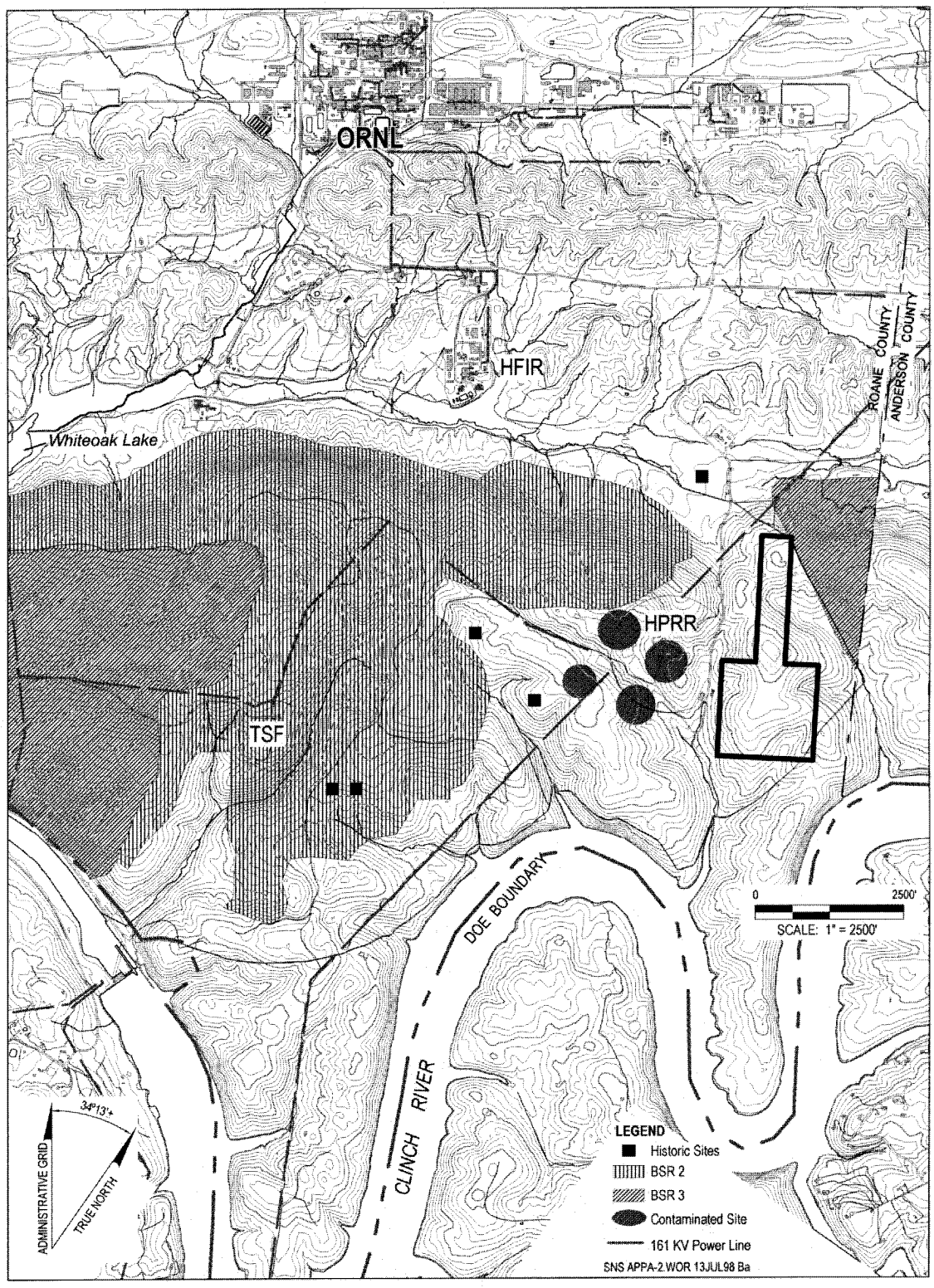
- Site avoids existing hazardous materials areas and waste areas [i.e., Waste Area Groups (WAGs) and Resource Conservation and Recovery Act (RCRA)].

- Site must not be on a geologic fault (seismic).

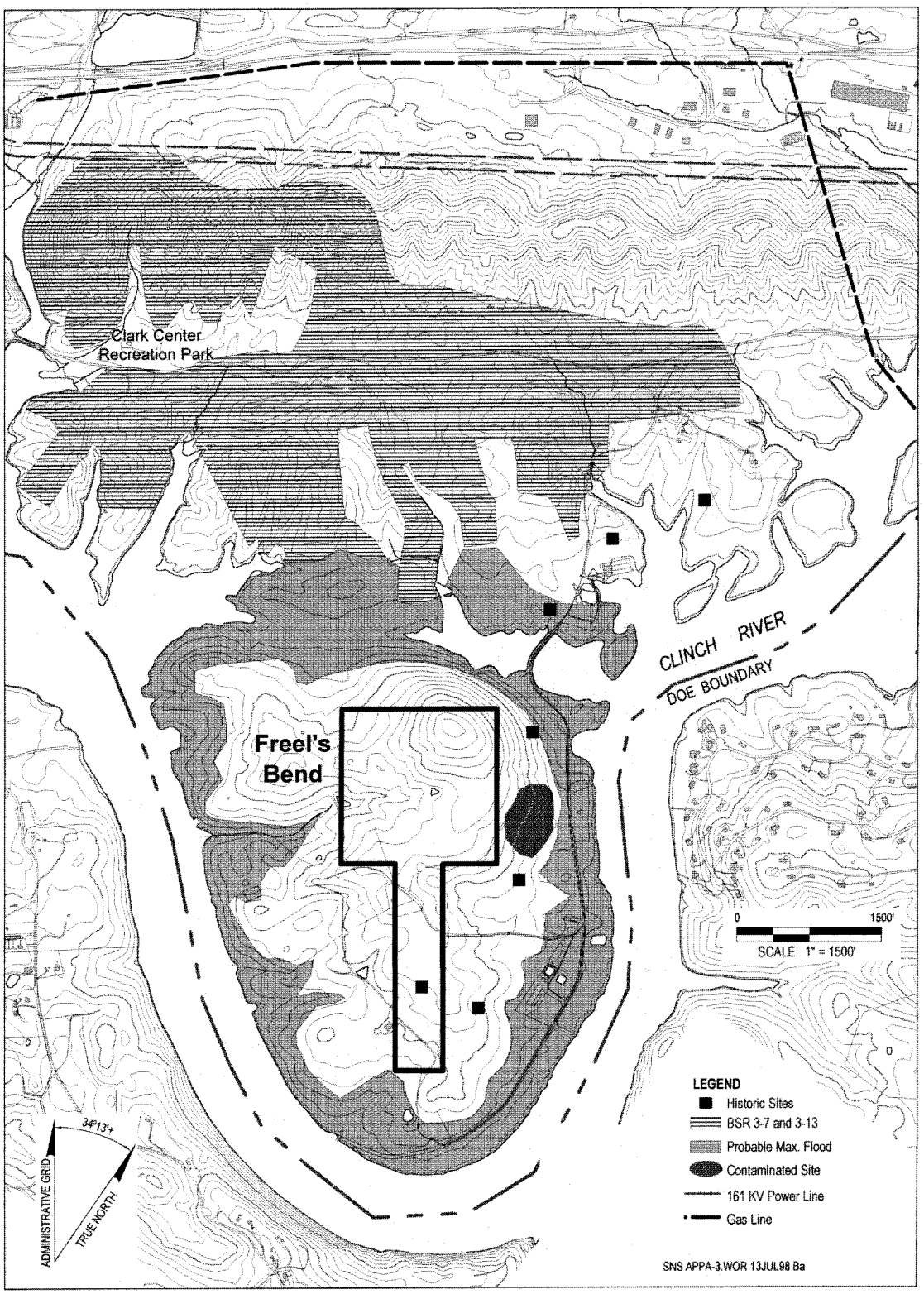
- Site provides a minimum 500-meter (1640 feet) separation from existing occupied structures (1000 meters desirable). Avoid close proximity to residential areas.



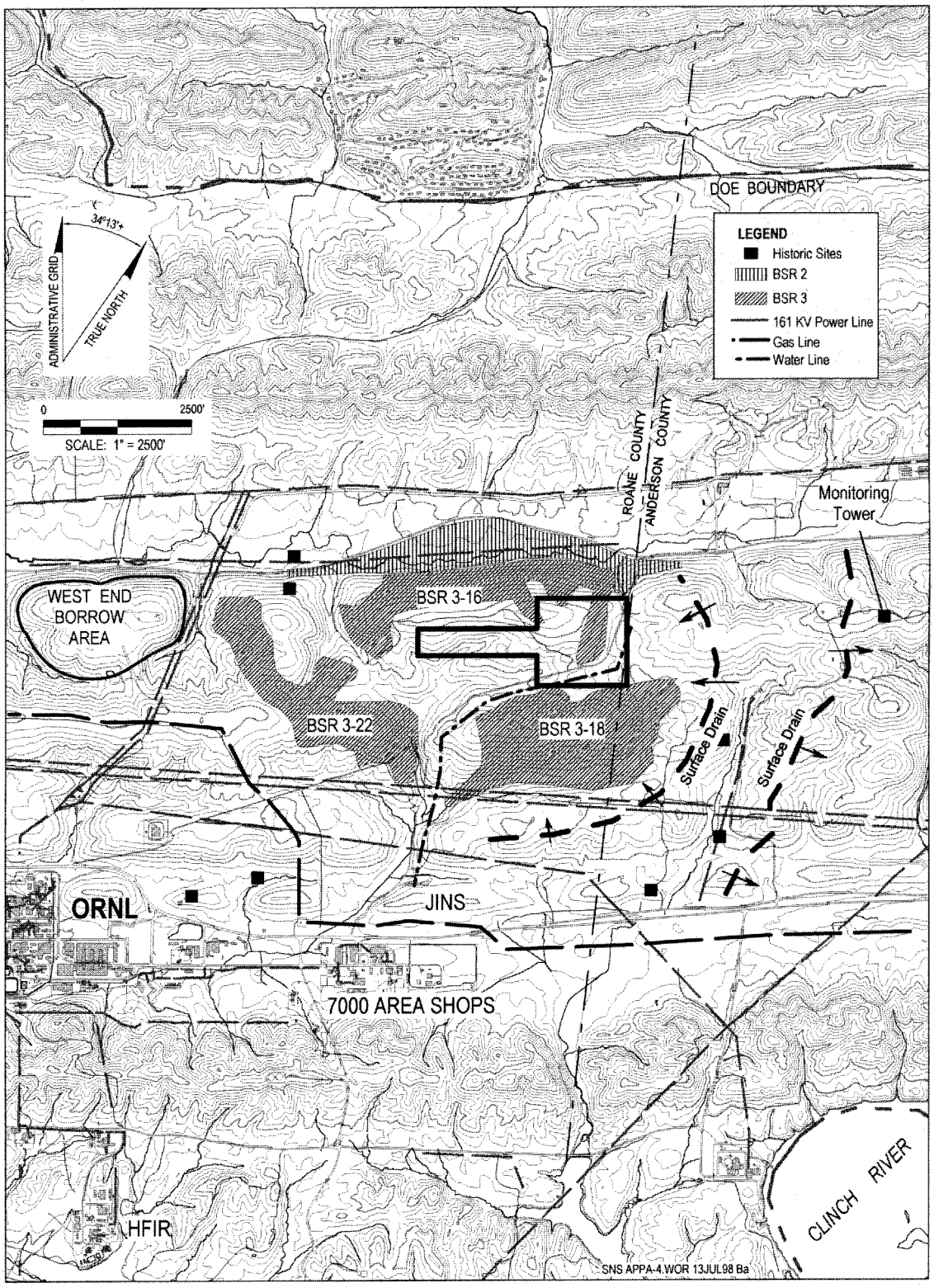
Area South of HFIR (Alternative 1)



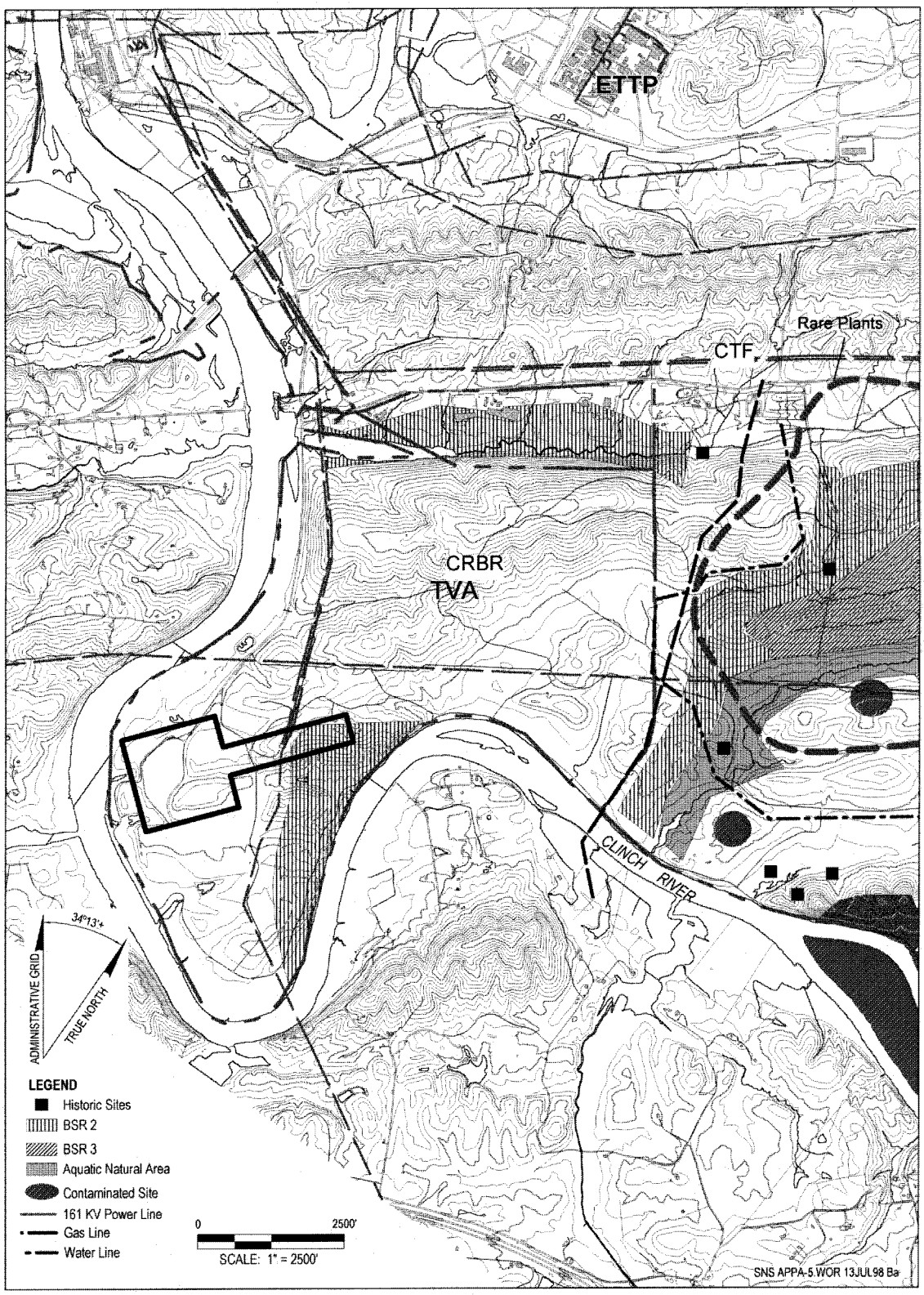
Area East of HPRR (Alternative 2)



Freels Bend Site (Alternative 3)



Chestnut Ridge Site (Alternative 4)



Clinch River Breeder Reactor (CRBR) Site

EXHIBIT 2

RESERVATION MANAGEMENT ORGANIZATION REVIEW COMMENTS ON THE SNS FACILITY SITING STUDY

This page intentionally left blank.

LOCKHEED MARTIN

Memorandum

Date: June 25, 1997

To: Fred R. Mynatt

c: H. M. Braunstein, J. B. Bussell (ETMC), T. R. Butz, R. Cox (ORAU), J. E. Cleaves, L. T. Cusick, S. G. Garland, R. P. Hosker, Jr. (NOAA/ATDD), D. T. Kendall, F. C. Kornegay, J. M. Loar, A. R. Medley, J. R. Newman, J. B. Overly, K. K. Baksa, P. D. Parr, J. D. Peebles, R.C. Peters, J. G. Rogers, W. K. Simon, D. S. Shriner, W. W. Thompson, Jr.

From: W. W. Teer, Jr., 1009COM, MS-8320 (6-0102)

Subject: **Reservation Management Organization (RMO) Review of Siting Study - National Spallation Neutron Source Facility**

On April 3, 1997, Mr. John E. Cleaves, Project Manager, National Spallation Neutron Source (NSNS) Facility presented the subject siting study (attached as Exhibit "1") to the RMO for review and comment. The RMO's review of the siting study has been completed and its' comments and recommendations concerning the four proposed sites (one preferred and three alternates) are summarized below:

GENERAL COMMENTS

1. The RMO recognizes the importance of the NSNS project to the Oak Ridge area and supports it.

2. Significant geologic concerns have been raised questioning the karst topography and related hydrologic transport on the preferred Chestnut Ridge Site. Flow paths from releases at this site have been traced to springs along Scarboro Creek and to the west of the site. The RMO strongly recommends a similar confirmation of flowpaths.

3. A detailed and time consuming preliminary analysis was done by the National Oceanic and Atmospheric Administration (NOAA) to evaluate potential impacts of the NSNS siting on their research site adjacent to Walker Branch Watershed resulted in prolonged response time for this RMO review.

This preliminary analysis indicates that NOAA measurements will be impacted by the siting of NSNS adjacent to their monitoring facility. The level and significance of this impact, however, has not yet been determined. NOAA has made a request for additional information and time to complete more detailed modeling analyses.

The RMO recommends that NSNS project personnel work directly with NOAA researchers to minimize/mitigate any potential impacts to their research and monitoring programs if the preferred Chestnut Ridge site is selected.

Fred R. Mynatt
June 25, 1997
Page 2

4. The RMO recommends that the CRBR site be considered. This site has many advantages over the proposed alternatives: it has been studied in detail (has an Environmental Impact Statement); it would avoid impacts to the resources on the ORR; it would provide ample space for all facilities; it would afford expansion, if desired; it is close enough to ORNL; and it apparently meets many of the NSNS site selection criteria.

CHESTNUT RIDGE (PREFERRED SITE)

Geologic and Hydrologic Concerns

Karst development and conduit-related flowpaths are most developed along the Knox outcrop belt. These are sensitive areas from a hydrology perspective since any releases are rapidly transported through the system and there is little potential for remediation after-the-fact. In this case, both the primary and secondary sites are directly atop the Knox dolomite. This unit is known to have well developed karst and this is documented in karst inventory work recently completed. Further, if one considers the potential for collapse (such as is evidenced in the Mona Lane case in Oak Ridge), structural stability is questionable and the highest occurrences of collapse occurs in the Knox. Thus if there is any need for structural integrity, NOT documented in the siting needs list, these sites are possibly poorly situated. The most favorable locations would lie in outcrop belts of the Conasauga group or Rome formation, such as Pine Ridge, Haw Ridge, Melton Valley. It would also seem that in the case of Melton Valley, there is a wealth of information and monitoring network which would allow for release detection, etc. Given that one of the criteria was the potential for anchoring into sound bedrock, the question arises as to how these sites emerged at all.

Based upon ORNL karst inventory work, there are a number of sinkholes which form a linear trend that persists all along the ridge line. There are a number of documented sinkholes that exist along the south slope of the primary site location. This suggests a well developed conduit network (to have accommodated removal of the soil/overburden mass from these sinkholes).

Further, though the candidate site is located atop a relatively flat hilltop in the Knox with incised drainages on two sides, this also suggests potential for radial releases of any contaminants should this occur. Flow in bedrock is typically strike-parallel which would either be to some of the springs that exist along westerly bounding drainage (which flows north towards Y-12) or the southerly bounding drainage (which flows towards Bethel Valley), if not beyond these. Based upon dye tracer work at the Y-12 Security Pits site located directly along strike to the east, flow paths from releases at this site have been traced to springs along Scarboro Creek and to the west of the site.

The accompanying proposal text cites a minimal demand for containing groundwater "runoff" due to its limited 'encatchment' area. In karst settings, topographic expression in no way delineates watershed and thus catchment areas. Further, as evidenced from similar settings along Black Oak Ridge, the overburden developed above the cherty Knox group bedrock consists of silty clay and gravel zones the latter of which are laterally end vertical extensive relict chert bedding zones. These zones can be shown to 1) serve as primary, quick routes of transport of contaminants to the underlying

Fred R. Mynatt
June 25, 1997
Page 3

bedrock and 2) serve as pressure relief valves for the underlying karst network such that water from the conduits is transmitted to shallow depths along these features (sort of like fingers of higher heads extending above the average water table). This may impact shallow construction.

The criteria of encountering sound rock within reasonable depth of cut is questioned. Typically, the thickest overburden is encountered on hilltops over the Knox, such as in these two sites. Depth to rock may easily reach 60-80 ft on the ridgetop.

One resource representative has suggested that an alternate site that should possibly be considered from a hydrologic/geologic perspective (not necessarily based upon existing infrastructure elements). This alternate site would be in the relatively flat area in the 8000 area of ORNL near the Clinch River. This area is underlain by less permeable Conasauga group clastic bedrock overlain by alluvial deposits. Groundwater flow in this suggested alternate site is much more predictable and monitorable, there is electric power service, more structurally competent bedrock, and relatively good/easily improvable access from Highway 95.

Potential Research and Monitoring Impacts

A preliminary analysis by NOAA/Atmospheric Turbulence and Diffusion Division (ATDD) indicates that NOAA measurements will be impacted by the siting of NSNS adjacent to their monitoring facility. The level and significance of this impact, however, has not yet been determined. NOAA has made a request for additional information and time to complete more detailed modeling analyses.

A May 30, 1997 memorandum from Dr. R. P. Hosker, Director of NOAA/ATDD is included at the end of this response. See Exhibit 2.

At this point, there is no information on chemicals that would be used during operation of the facility, although researchers could possibly bring such things with them. Also there are no plans for a steam plant, but if one were needed it would probably be gas-fired.

Evaluation of impacts to on-going or potential future ORNL Environmental Sciences Division ecological research has concluded that the probability for negative impacts is minimal, however, geologic/hydrologic review of subsurface transfers is recommended to ensure that the Walker Branch Watershed 30-years hydrologic record is not compromised. A subsidiary issue which would impact the National Precipitation and Dry Deposition Monitoring Netword site on Walker Branch Watershed, at a minimum, would be the use of chemical biocides in cooling tower waters.

Environmental Regulatory Impacts

An ORNL regulatory monitoring station, which is a reference sampling station for NPDES surface water monitoring as well as radiological parameters, is located on White Oak Creek. The station is located at the headwaters, which are on the crest of Chestnut Ridge quite close to the proposed NSNS site. Data collected at the station provide background information at a "clean" site, against which other data is compared for evidence of contamination. Care would be required during construction on the ridge to protect the monitoring station and keep it "clean."

Many other small streams that drain the ORR, including Chestnut Ridge, have recently been added as surface water sampling sites. These include Grassy Creek, Ish Creek, Northwest Tributary, and Raccoon Creek. It will be important to prevent soil erosion during construction on the ridge to protect all streams and creeks from compliance violations due to excessive suspended solids (i.e., sedimentation). In addition, these streams could be in violation of compliance limits subsequent to construction as a result of runoff from landscaped areas and roads and parking lots.

The preferred site is located in the Bear Creek watershed, and covered under the Y-12 NPDES Permit. Currently, only storm water type discharges are permitted in this area. Any process type discharges would have to be negotiated with state or local regulatory authorities. Several options are possible regarding the treatment/discharge of waste waters, some options could require a modification to the NPDES Permit.

Y-12's NPDES monitoring point S-24, rad monitoring point 304, and spring SS-5, could potentially be affected by the construction and operation of this 100 acre facility.

More information would be needed to fully assess other permitting needs, including air permitting, however, this need not be a problem.

Potential Impacts to Streams and Wetlands

No federal jurisdictional wetlands were identified in the site characterization area, consisting of the proposed boring locations and drill rig access paths, in a survey of the site conducted on March 11, 1997. Based on surveys in many areas of the ORR, ridge tops are considered to be highly unlikely locations for wetlands, with the possible exception of sinkholes and depression contours.

Adverse impacts to offsite wetlands and headwater tributaries of White Oak Creek immediately southeast of the site can occur unless effective erosion control measures are implemented prior to construction to prevent runoff and siltation of these important habitats. Care must also be taken to avoid erosion due to access path clearing and boring (e.g., escape of drilling muds) during any characterization activities.

A major spring just north of the site provides significant flow to Bear Creek, which has the Tennessee dace, a species listed as in need of management by the Tennessee Wildlife Resources Commission. Effective measures must be taken to prevent siltation of this headwater spring. Likewise, any long-term impact to the ecologically fragile seep-fed wetlands in the Bear Creek Spring Area at the base of Chestnut Ridge must be avoided.

A critical concern regarding the development of Chestnut Ridge is the long-term impact to the ecologically fragile seep-fed wetlands in NA52 (Bear Creek Spring Area) at the base of Chestnut Ridge. Adverse impacts which would over time destroy or degrade this sensitive habitat include: changes to the local hydrology and drainage patterns as a result of up-slope grading, construction and paving; increased erosion and siltation/sedimentation as a result of up-slope grading and construction; and chemical run-off from landscaped areas (fertilizers and pesticides) and roads (petrol-chemicals and salts).

Fred R. Mynatt
June 25, 1997
Page 5

Potential Impacts to Ecologically Sensitive Areas

The NSNS site overlaps several environmentally sensitive areas, including a National Environmental Research Park Natural Area (NA52; Bear Creek Spring Area) and three Preliminary Conservation Sites recommended for protection by The Nature Conservancy (BSR2-10, BSR3 16, and Landscape Complex 1). Additionally, the oak-hickory forest area on the southeast facing slope of Chestnut Ridge drains toward ecologically sensitive streams and wetlands in NA55 (Chestnut Ridge Springs Area), ARA6 (Upper White Oak Creek), BSR3-22, and BSR4-3. This forest provides significant landscape connectivity between NA52 and NA55. Parts of this forest should be protected (due to drainage effects) for increased natural area viability. Potential adverse impacts to environmentally sensitive areas include (1) reduction in T&E species habitat quality; (2) introduction or spread of exotic species; and (3) forest fragmentation and reduced landscape connectivity between Natural Areas.

Potential Impacts to T&E Wildlife and Plant Species

Although no extensive surveys for T&E wildlife have been conducted in the Chestnut Ridge area, a reconnaissance was conducted recently and several state-listed birds could occur there. Also, the Chestnut Ridge area of the ORR exemplifies the unfragmented hardwood habitat that is so increasingly scarce in the region. Protection and enhancement of such habitat would help protect interior forest species, such as bats (e.g., Rafinesque's big-eared bat and the Indiana bat) and neotropical migrant songbirds (e.g., Cerulean warbler).

The following three Tennessee-listed vascular plant species and an additional species which is highly ranked by The Nature Conservancy were determined to be present in the surrounding area during previous surveys, and potential habitat for these species exists onsite:

- Pink lady-slipper (Cypripedium acaule) / TN-Endangered
- Golden seal (Hydrastis canadensis) / TN-Threatened
- Ginseng (Panax quinquefolius / TN-Threatened
- Whorled horsebalm (Collinsonia verticillata) / The Nature Conservancy global ranking-High

Potential Impacts to Borrow Area

The NSNS Site Selection dialogue indicates the need for a storage area for backfill material and for spoils material, and that the "now exhausted Chestnut Ridge borrow area" could serve in that capacity. This conflicts with recent information obtained by the Environmental Restoration organization, where surveys have shown a large amount of soil for closure activities and other borrow material needs. Since this borrow area (a.k.a. West Borrow Area) is the only active borrow area on the ORR, consideration should be given to 1) selecting another soil storage area, possibly adjacent to the NSNS Site or, 2) selecting a replacement area with suitable clay to serve the regular needs of the ORR for closure/borrow material.

Fred R. Mynatt
June 25, 1997
Page 6

Potential Impacts to Cultural Resources

A preliminary cultural resource literature review indicates that there is at least one pre-1942 homestead near the west boundary of the Chestnut Ridge site. To comply with the National Historic Preservation Act, a Section 106 survey would be required for all of the 100 acres proposed for construction. No major archeological or historical sites are anticipated in this area however.

Other Considerations

There is great potential for erosion during construction as well as during operation of the facility. Both sides of the ridge are steep and may be very difficult to stabilize after clearing trees.

Soil data is available electronically (GIS) and should be useful in evaluating the site.

The site selection included karst rock formation, but excluded sinkhole areas. All karst areas have the potential for future sinkhole formation and underground caves. Sinkhole survey information is also available.

Part of the Aerial Survey program conducted by Environmental Restoration Program included the use of remote sensing magnetometers, etc. that might help identify more details associated with near surface caves, etc. (e.g., something less than solid rock). Richard Durfee's GIS group may have that data.

All environmental issues would be examined during the required NEPA review.

There do not appear to be any security consideration for this or any of the other potential sites. During the design phase, PSO needs to be involved to patrol guidance on elements such as barriers, property protection, access control, and Protective Force and Fire response.

From a radiological control perspective, there are no substantive comments on the identification of this or any of the other potential sites at the ORR. Obviously, the design of the facility will require consideration for shielding and dose control to workers, but that will occur later if project proceeds.

SOUTH OF HFIR AND EAST OF TSF (ALTERNATIVE #1)

Potential Impacts to Cultural Resources

This area includes the Gravel Hill Cemetery and several standing structures that made up the Gravel Hill Community, once supporting a school for that portion of Roane County. Recent surveys have shown that some of these sites are individually eligible for the National Register of Historic Places (NRHP), and collectively the area is eligible as a historic district. Additional surveys and considerable mitigation would be required to develop this area.

Potential Impacts to T&E Species

The following TN state-listed species was determined to be present in the surrounding area and may be present within the site: Ginseng (Panax quinquefolius) / TN Threatened. This site encroaches on a Preliminary Conservation Site recommended for protection by The Nature Conservancy (Landscape Complex 2). Without more detailed mapping of this site, it is not possible to identify any other encroachments on Environmentally Sensitive Areas.

Other Potential Environmental Impacts

Measures must be taken to avoid impacts on the extensive Copper Ridge Cave Reference Area system.

EAST OF HPRR (ALTERNATIVE #2)

Potential Impacts to Cultural Resources

This area includes some old home sites that recent surveys have documented as not eligible for the NRHP. An additional survey and little or no mitigation is likely for developing this area.

Potential Impacts to T&E Species

The following TN state-listed species were determined to be present in the surrounding area and may be present within the site:

- Ginseng (Panax quinquefolius) / TN Threatened
- Lesser ladies-tresses (Spiranthes ovalis) / TN Special Concern
- Appalachian bugbane (Cimicifuga rubifolia) / Federal Special Concern (former C2 candidate), TN Threatened

The following TN state-listed species were determined to be present in the surrounding area and may be adversely impacted by offsite effects of development (such as changes in local hydrology and drainage patterns, and increased erosion and sedimentation):

- Spreading false-foxglove (Aureolaria patula) / Federal Special Concern (former C2 candidate), TN Threatened
- Carey saxifrage (Saxifraga careyana) / TN Special Concern.

Potential Impacts to Ecologically Sensitive Areas

The site encroaches on a Preliminary Conservation Site recommended for protection by The Nature Conservancy (Landscape Complex 2). Without more detailed mapping of this site, it is not possible to any identify other encroachments on Environmentally Sensitive Areas.

The TN state-listed sharp shined hawk and yellow bellied sapsucker have been observed in the Park City Road area adjacent to the site. Also, this site is less desirable than the others because of the additional disturbance that would occur to meet road and other infrastructure requirements.

FREELS BEND AREA (ALTERNATIVE #3)

Potential Impacts to Cultural Resources

This area includes a valuable cultural resource, the Freels Cabin, listed on the National Register of Historic Places (NRHP). In addition, the site contains several archeological areas where Native American artifacts have been recovered. A considerable amount of investigation and evaluation, including consultation with the State Historic Preservation Officer, would be required for proposed projects in this area.

Potential Impacts to T&E Species

This site is the only site that has been surveyed for T&E wildlife. State listed in-need-of-management species on this site include: southeastern shrew, Sharp-shined and Cooper's hawks, great egret, northern harrier, yellow-bellied sapsucker, and grasshopper sparrow. The federally threatened bald eagle has been observed during the winter, and the state threatened osprey nests in the area. This is an excellent wildlife site, providing a mosaic of fields, hedgerows, woodlots, and water, an increasingly rare combination in the region. Development of this site would entail additional disturbance to wildlife habitat (compared to the preferred, TSF, or CRBR sites) for road improvement and other infrastructure development.

This site also encroaches on a Cooperative Management Area for T&E species (CMA 3), Lower Freels Bend Meadows. However, it is possible that the development of the NSNS at this site would be compatible with continued management of the surrounding area for T&E species.

Other Considerations

The mid-part of Freels Bend supports the Ecological and Physical Sciences Study Center, an important educational field resource for school children and teachers.

Hay grown on Freel's Bend is sampled and analyzed for radionuclides in compliance with the regulatory requirements in DOE Order 5400.1 to be incorporated into 10 CFR 834. The results are reported in the publicly available ORR Annual Site Environmental Report.

If you have any questions, please do not hesitate to contact me.

WWT:JRN:PDP:bsb

Attachments

EXHIBIT 3

RESERVATION MANAGEMENT ORGANIZATION RECOMMENDATION FOR SITING THE SNS FACILITY

This page intentionally left blank.

LOCKHEED MARTIN

Memorandum

Date: August 15, 1997

To: Richard K. Genung, Fred R. Mynatt

c: B. R. Appleton, K. K. Baksa, H. M. Braunstein, D. G. Lund (ETMC), T. R. Butz, J. E. Cleaves, R. Cox (ORISE), L. T. Cusick, S. G. Garland, R. P. Hosker, Jr. (NOAA/ATDD), D. T. Kendall, F. C. Kornegay, J. M. Loar, A. R. Medley, J. R. Newman, J. B. Overly, P. D. Parr, J. D. Peebles, R. C. Peters, J. G. Rogers, D. S. Shriner, W. K. Simon, W. W. Thompson, Jr., D. K. Wilfert

From: W. W. Teer, 1009COM, MS-8230 (576-0102)

Subject: **Reservation Management Organization Recommendation for Siting the National Spallation Neutron Source (NSNS) Facility**

Recommendation

The Reservation Management Organization (RMO) recommends the Chestnut Ridge Site on the southern slope of Chestnut Ridge immediately west of the Roane/Anderson County line and Chestnut Ridge Road as the preferred site for the National Spallation Neutron Source (NSNS). Issues of concern raised in the June review by the RMO (W. W. Teer, Jr. to F. R. Mynatt, June 25, 1997) have been adequately addressed. This site is shown as the "Primary Site" on the accompanying map. RMO approval of this does not preclude the need for National Environmental Policy Act (NEPA) documentation, Area Manager approvals, or other reviews as required.

Background

The NSNS project has developed requirements and criteria and has performed a selection process that identified Chestnut Ridge as the primary site. Several alternative sites have been identified. The RMO was informed of the NSNS project in November 1995, and the selection process was formally submitted to them on April 3, 1997.

Richard K. Genung, Fred R. Mynatt
Page 2
August 15, 1997

RMO representatives identified issues and provided comments and suggestions regarding the NSNS site selection. They were summarized in a memorandum from W. W. Teer, Jr. to F. R. Mynatt, dated June 25, 1997.

The Chestnut Ridge site is the best site for NSNS because:

a) It is the most cost effective site. It is near roads, utilities, and construction-borrow areas; it has the best situation for transport of waste and use of ORNL shops, security, and other facilities; and it has the most advantageous topological configuration for site excavation and construction of berm shielding.

b) It has the least potential impact on the environment and the public. The site avoids wetlands, blue line streams, historical sites, threatened and/or endangered species, and other environmental impacts as well or better than the alternative sites. It is also the most remote from public access areas.

c) It has the best location for supporting ORNL neutron sciences programs.

d) It will be located close to the site preferred for JINS, which will support neutron science programs at ORNL, High Flux Isotope Reactor (HFIR), and NSNS.

Issues and Resolutions

The major issues regarding the Chestnut Ridge site are that its karst topography could adversely impact construction, and the NSNS construction could adversely impact environmental science research at the Walker Branch Watershed (WBW) area located east of the site and the White Oak Creek headwaters south of the site.

Cognizant personnel from ORNL and the National Oceanic and Atmospheric Administrations (NOAA) were contacted to evaluate and resolve these issues. The issues addressed, and their corresponding resolutions, are described below.

Construction on Karst Topology

Present information about foundation stability requirements, preliminary foundation design work, shock test data from ORNL, and preliminary core borings indicate that construction on Chestnut Ridge will not be a problem if approached correctly. Further, construction on Karst topography is not uncommon in the Knoxville area and/or on the Oak Ridge Reservation.

Richard K. Genung, Fred R. Mynatt
Page 3
August 15, 1997

Further study of ORNL geological data from magnetometer measurements and much more core boring in FY 98 will be used to confirm the situation.

The NSNS project team will employ an integrated approach and/or plan that is generated with appropriate stakeholders and subject matter experts. A workshop with appropriate stakeholders and experts will define the issues and identify the technology available to measure, monitor, design, etc. Information from the workshop and existing ORNL data will be used to plan for core boring (including considering how bore holes might be used for monitoring wells and other items in the future), excavation, and lead into foundation design.

NOAA Research Issues

Dust from construction could affect the long-term monitoring of wet and dry deposition of key air pollutants. This potential impact will be of short duration (less than 1 1/2 years with most activity occurring in the first 7 to 8 months), and it is presently felt that this impact can be handled with normal dust control methods, possibly some additional measurements taken during construction, and other data protection means.

Carbon dioxide and nitrogen oxides from natural gas water heaters to generate building heat could affect studies of carbon dioxide uptake. This impact is not expected to be significant, and if it is, it can be handled by changes in the NSNS design (to provide heat a different way for example).

The heat and water vapor plume from the cooling tower could affect the measurement of air-surface exchange of momentum, heat, and water vapor. Modeling of the cooling tower will be performed in FY 98 to quantify the impact and examine the virtues of different cooling tower locations and arrangements to determine how best to mitigate the impact. This modeling will lead to an acceptable design. If not, a second research tower will be built at a suitable location far enough in advance of site excavation to calibrate it with respect to the existing tower and conditions.

White Oak Creek Impact

Construction on the Chestnut Ridge site could impact aquatic habitats and monitoring activities in the headwaters of White Oak Creek.

Technology to properly protect White Oak Creek from silt and other construction hazards is available. Proper planning and monitoring of construction activities will prevent adverse impacts.

Richard K. Genung, Fred R. Mynatt
Page 4
August 15, 1997

ORNL personnel will assist the NSNS team input requirements into conventional facilities requirements documents and the RFP for the Architect Engineer/Construction Manager contract. The NSNS project team will also conduct workshop(s) with experts in construction near sensitive areas to make sure that all the technology and tricks of the trade available are applied. This and plans, monitoring, and frequent meetings with the stakeholders during land survey, core boring, excavation, and other high activity times should provide acceptable results.

Construction Impact on Deep Subsurface Hydrology

NSNS site excavation could change the deep subsurface hydrology that very often exists with a karst topology to the degree that it causes an adverse impact on the WBW subsurface hydrology. This effect would occur primarily because the water table will be lowered when excavation occurs.

Well measurements during construction could be used to "recalibrate or adjust" the existing WBW data.

Assessment of potential impacts will be determined by performing drawdown and pump tests and examing magnetometer data. Based on drawdown and pump test results, tracer tests and, if warranted, modeling of the excavation design will be performed.

Consideration of Alternate Sites

The RMO suggested consideration of the Clinch River Breeder Reactor (CRBR) site (one of the alternative sites identified) and the Oak Ridge National Laboratory (ORNL) 0800 area across the Clinch River from Jones Island. The CRBR site is considered unacceptable because its location is too distant from other neutron sciences research facilities and the acceptable locations for the Joint Institute of Neutron Sciences (JINS) facility, and because it is owned by the Tennessee Valley Authority (TVA). Acquiring the site from TVA would likely cause an unacceptable cost and/or schedule impact to the NSNS project. The 0800 area is too small for NSNS construction and would cause adverse impacts to environmental sciences research in that area.

Summary

An NSNS project Design Team will have environmental components appropriately integrated (with representation, for example, from NOAA, Tennessee Wildlife Resources Agency, ORNL Environmental Sciences Division, National Environmental Research Park, etc.) This team will also pursue creative approaches for additional environmental research opportunities offered by the NSNS facility. Communication with RMO on implementation of these resolutions will be provided, and major changes in siting will be brought to the RMO for consideration.

Richard K. Genung, Fred R. Mynatt
Page 5
August 15, 1997

In conclusion, it is felt that Chestnut Ridge provides the most advantageous location for the facility, that solutions and fallback positions exist for the issues raised. Consequently, the RMO recommends that the Chestnut Ridge should be designated as the preferred site for NSNS construction.

If you have any questions or need additional information, please do not hesitate to contact m.

WWT:JRN:sgl

Attachment

Phone: (423) 576-0102
FAX (423) 241-3597
INTERNET: wwt@ornl.gov

This page intentionally left blank.

LOS ALAMOS NATIONAL LABORATORY
SITE SELECTION REPORT

This page intentionally left blank.

National Spallation Neutron Source
Los Alamos National Laboratory
Site Selection Report

Prepared for the
United States Department of Energy/
Oak Ridge Operations Office

Prepared by

The Planning Office of
Facilities Safeguards and Securities Six (FSS-6)
and Ecology Group (ESH-20)

Los Alamos National Laboratory
Los Alamos, New Mexico

March 28, 1997

NATIONAL SPALLATION NEUTRON SOURCE
LANL SITE SELECTION REPORT

Los Alamos National Laboratory
March 28, 1997

INTRODUCTION

This report evaluates four potential sites for construction of the National Spallation Neutron Source (NSNS) at Los Alamos National Laboratory (LANL) in Los Alamos, New Mexico. In 1995 the Department of Energy (DOE) determined that NSNS would require an Environmental Impact Statement (EIS). The DOE then developed a process to identify suitable alternatives to the DOE's "preferred alternative" at Oak Ridge National Laboratory (ORNL). The process evaluated 39 DOE sites, and LANL qualified as one of three alternative locations besides ORNL for the facility. The other two alternative locations were Argonne National Laboratory and Brookhaven National Laboratory. *(Draft National Spallation Neutron source Project, Alternate Site Selection Report; US Department of Energy, Office of Energy Research; prepared by Roy F. Weston, Inc., August 23, 1996)*

This report provides the NSNS program with a decision-making tool for selecting an alternative candidate site at Los Alamos National Laboratory for the NSNS facility. The site evaluation process uses the following steps for selecting a recommended site:

- List NSNS physical design parameters provided by the NSNS design team
- Inventory of candidate LANL sites
- Evaluation of each candidate site according to NSNS siting criteria
- Determination of the candidate site with the best attributes and least restrictions to accommodate the NSNS

Four candidate sites were identified from which the recommended site was determined to best meet the NSNS criteria: Technical Area* (TA-) 70, TA-33, TA-58 and TA-71. These areas and the project footprint are illustrated on the four maps presented at the end of this report.

NSNS SITE REQUIREMENTS

The NSNS site must accommodate several physical and environmental requirements. These requirements are categorized as functional, environmental, and programmatic and are listed below.

* LANL is divided into technical areas (TAs) that are used for building sites, experimental areas, waste disposal locations, roads, and utility rights-of-way. However, these uses account for only a small part of the total land area. Most land provides buffer areas for security and safety and is held in reserve for future uses.

Functional

- A site that accommodates a hammer-head shaped structure measuring 500 x 500 meters with a tail centered on the above square and measuring 100 x 500 meters
- A site that can be excavated to be level and founded on solid rock
- Additional space for support buildings and access roads requiring an additional 100,000 square meters
- Sufficient earth fill available on site or nearby to provide an average of 15 feet cover for shielding over the hammer-head shaped area
- Reasonable proximity to other facilities at LANL
- Reasonable access to a disposal area for rock and excess earth excavation
- Proximity to stockpile areas for earth excavation for covering and shielding the main structure
- Avoid significant overhead and underground utility relocation (e.g., power lines, water line mains and gas transmission lines, steam lines)
- Minimize runoff to, through and from the site
- Reasonable access to existing utility systems to include:
  - 40 MW electrical power
  - potable water
  - compressed air, natural gas, sanitary sewer, steam and chilled water (desirable, can be provided by on-site facilities)
  - availability of construction power within one mile
- Reasonable proximity to primary and/or secondary paved roads for users, researchers, materials, supplies; for target transport; for waste and irradiated material removal
- Buffer zone to avoid residential areas and large worker populations

Environmental

- Avoid construction in floodplain
- Avoid construction in or disturbance of wetlands
- Avoid locations with threatened or endangered plant or animal species
- Avoid Solid Waste Management Units (SWMUs) and Potential Release Sites (PRSs)
- Minimize impact on National Environmental Research Park (NERP)

Programmatic

- Conform with appropriate site development and land use plans
- Avoid existing recreation uses

INVENTORY OF CANDIDATE LANL SITES

Siting and construction of the NSNS facility is a major undertaking requiring a large site. While LANL covers 43 square miles, much of the terrain is rugged canyons separated by

high mesas. Many sites are presently developed, and there are limited undeveloped sites of adequate size where the NSNS facility would have sufficient land. Of the total available sites some are too small in area or are isolated and/or geographically separated from major developed areas of the laboratory. Several sites are candidates for eventual transfer of ownership to Los Alamos County, nearby Pueblos or other entities.

There are only four sites that appear to meet the siting criteria and that are considered here for development of the NSNS facility. These sites are TA-70 (Alternative Site # 1); TA-33 (Alternative Site #2); TA-58 (Alternative Site #3) and TA-71 (Alternative Site #4). Each of these sites is evaluated according to the above siting criteria. Table 1 presents the summary evaluation of the four potential candidate sites according to the siting criteria for the NSNS facility.

Table 1. Analysis of Siting Criteria at Four Potential LANL Sites

Siting Criteria	TA-70, Alternative Site #1	TA-33, Alternative Site #2	TA-58, Alternative Site #3	TA-71, Alternative Site #4
FUNCTIONAL				
1. Physical accommodation of building footprint (500 m x 500 m with attached 100 m x 500 m addition) at same elevation and founded on sound rock	Adequate	Adequate	Too small	Adequate
2. Adequate earth backfill to provide an average of 15 feet cover for shielding	Adequate	Adequate	Adequate	Adequate
3. Close proximity to LANL support facilities and services	Remote from existing facilities/ services	Remote from existing facilities/ services	Adjacent to existing facilities/ services	Remote from existing facilities/ services
4. Reasonable access to disposal area for rock and excess earth excavation	Reasonable access	Reasonable access	Reasonable access	Reasonable access
5. Avoid relocating significant overhead/underground utilities	Avoids underground utilities but requires realignment of overhead electrical line	Avoids underground utilities but requires realignment of overhead electrical line	Relocation of multiple utilities	Avoids underground utilities but requires realignment of 2 overhead electrical lines
6. Proximity/access to existing utility systems (40 MW power, potable water, compressed air, natural gas, sanitary sewer, steam and chilled water [desirable but can be provided on-site], construction power within one mile	Remote from existing utility systems	Remote from existing utility systems	Close to existing utility systems	Remote from existing utility systems
7. Proximity to primary and/or secondary paved road access	Adequate	Adequate; possible relocation of road required	Adequate	Adequate
8. Adequate buffer zone	Adequate	Close proximity to Bandelier National Monument	Adjacent to highly populated TA	Close proximity to residential area

Table 1 (cont.). Analysis of Siting Criteria at Four Potential LANL Sites

Siting Criteria	TA-70, Alternative Site #1	TA-33, Alternative Site #2	TA-58, Alternative Site #3	TA-71, Alternative Site #4
ENVIRONMENTAL				
9. Avoid disturbance of floodplains and wetlands	No adverse floodplain or wetland impacts	No adverse floodplain or wetland impacts	No adverse floodplain impacts, possible wetland impact	No adverse floodplain or wetland impacts
10. Avoid locations with threatened or endangered plant or animal species (0.25 mile radius)	Bald eagle roosting habitat	Bald eagle roosting habitat	Northern goshawk foraging habitat; unoccupied Mexican spotted owl habitat	No impact
11. Avoid locations with threatened or endangered plant or animal species (1.0 mile radius)	Bald eagle roosting habitat	Bald eagle roosting habitat; Peregrine falcon nesting habitat	Northern goshawk foraging habitat; Spotted owl roosting habitat	Bald eagle roosting habitat
12. Avoid SWMUs and PRSs	No SWMUs or PRSs	No SWMUs or PRSs	No SWMUs or PRSs	No SWMUs or PRSs
13. Avoid locations with historic, cultural, or archaeological resources present	Not surveyed but known to have cultural resources present	56% surveyed, cultural resources present	49% surveyed, no cultural resources identified yet	24% surveyed, cultural resources present
14. Minimize impact on National Environmental Research Park (NERP)	All LANL is within NERP boundaries	All LANL is within NERP boundaries	All LANL is within NERP boundaries	All LANL is within NERP boundaries
PROGRAMMATIC				
15. Compatible with site development and land use plans	Consistent with 1990 Site Development Plan and annual updates	Consistent with 1990 Site Development Plan and annual updates	Consistent with 1990 Site Development Plan and annual updates	Consistent with 1990 Site Development Plan and annual updates
16. Avoid existing recreation uses	Existing trails	Visible to hikers in Bandelier	Existing trails	Existing trails

EVALUATION OF CANDIDATE SITES

TA-58 (Alternative Site #3), has appropriate gross acreage, but its narrow shape and topography do not permit a sufficiently level site for construction of the facility on one level. There is also insufficient area for an adequate buffer around the site. TA-3, the most developed and populated of LANL's technical areas, is within 100 meters of the boundary of the potential site. Also, a major, multiple-utility corridor traversing the site would require relocation. Therefore, this candidate site has been eliminated from consideration.

Three remaining sites are of sufficient size to accommodate the NSNS facility: TA-33, TA-70 and TA-71. There is sufficient earth back fill to cover the facility for shielding at any of the sites, and reasonable access to a disposal area for excess earth excavation materials exists. Runoff to, through and from each of the sites could be minimized by standard engineering techniques. All three of these sites have direct access to New Mexico State Route Four. None of the sites have SWMUs or PRSs. However, none of the three sites are completely free from constraints, as discussed in the next paragraphs.

TA-70 (Alternative Site #1) is a completely undeveloped mesa except for a major electric power line that traverses the site. There are several unpaved paths used for recreational hiking. The footprint of the NSNS facility would cover an area with grade changes of 140 feet. There are no significant underground utilities requiring relocation, however, an overhead electrical line will require realignment. Adequate electric power can be made available. Potable water will have to be brought to the site, and compressed air, natural gas, sanitary sewer, steam and chilled water will have to be provided by on-site facilities. This site is within 0.25 mile of bald eagle roosting habitat. The site has never been surveyed officially for cultural resources but four archaeological sites have been recorded in the area.

TA-33 (Alternative Site #2) has been the site of former tritium laboratories and an explosive test site. It is also immediately adjacent to Bandelier National Monument where preservation of archaeological ruins and the natural environment is a major goal. TA-33 can accommodate the facility, but will require relocation of the road leading to an existing radio telescope facility and to a former explosives test site. The footprint of the NSNS facility would cover an area with grade changes of 120 feet. There are no significant underground utilities requiring relocation, however, an overhead electrical line will require realignment. Adequate electric power can be made available. Potable water will have to be brought to the site, and compressed air, natural gas, sanitary sewer, steam and chilled water will have to be provided by on-site facilities. This site is within 0.25 mile of bald eagle roosting habitat and within one mile of peregrine falcon nesting habitat. Twelve cultural resources have been recorded in the surveyed area of this alternative site.

TA-71 (Alternative Site #4) is another undeveloped mesa and similar to TAs-70 and 33. The footprint of the NSNS facility would cover an area with grade changes of 110 feet. Both an existing power line and a second power/utility line will have to be relocated. This site is adjacent to the residential community of White Rock which is less than one mile to

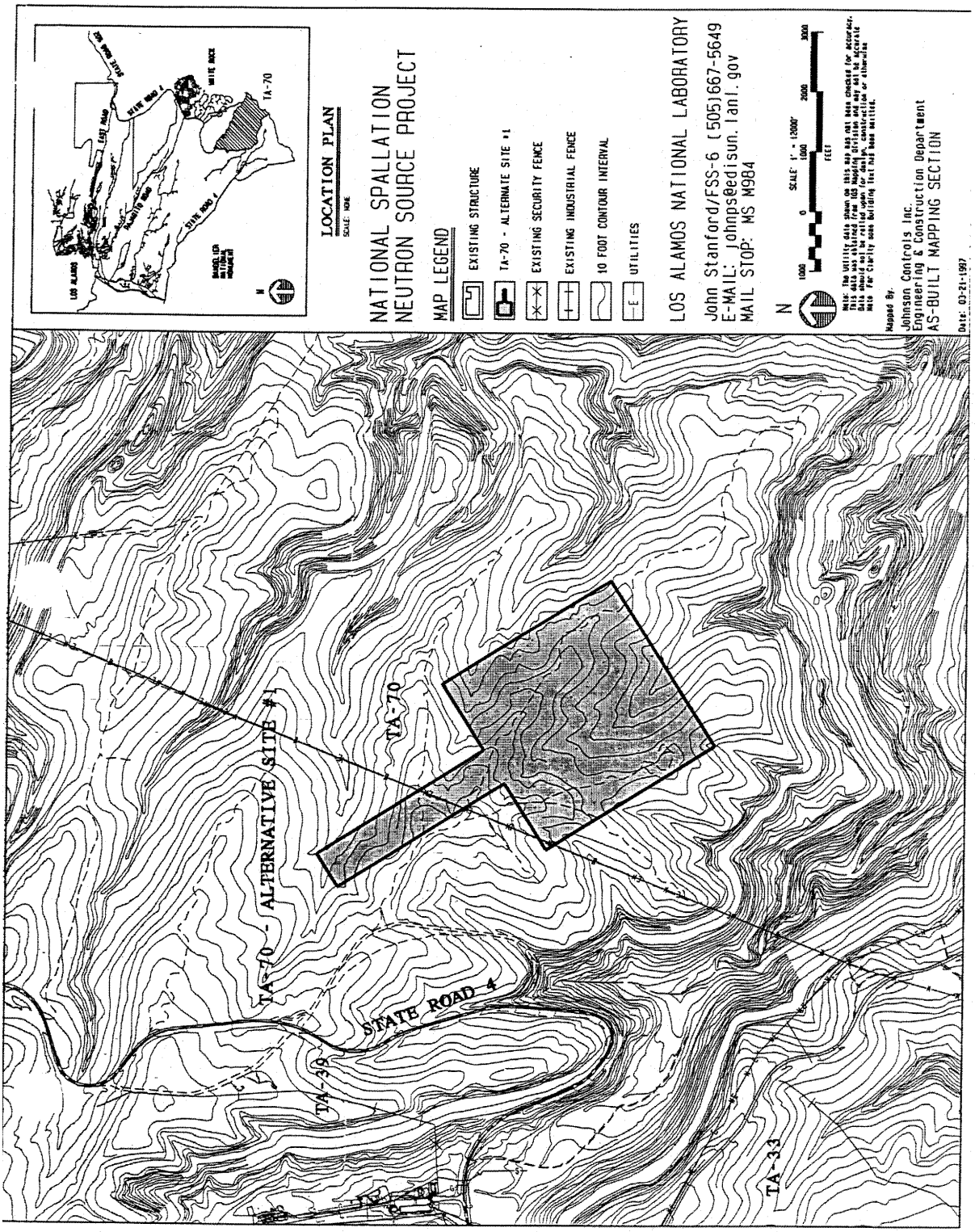
the east. This site is not within 0.25 mile of habitat for any threatened or endangered species. However, it is within one mile of bald eagle roosting habitat. Six cultural resources have been recorded in the surveyed area of this site.

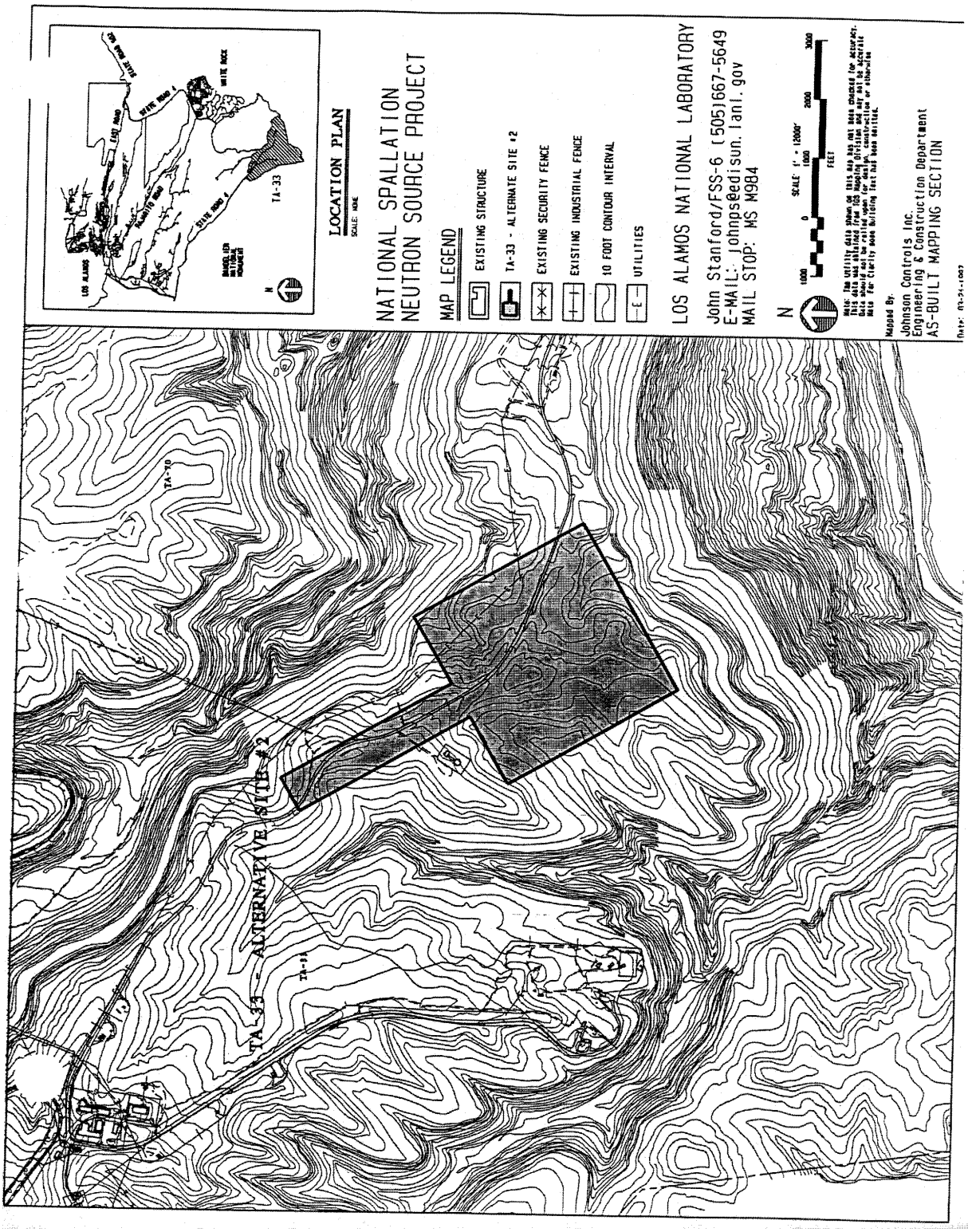
RECOMMENDED SITE

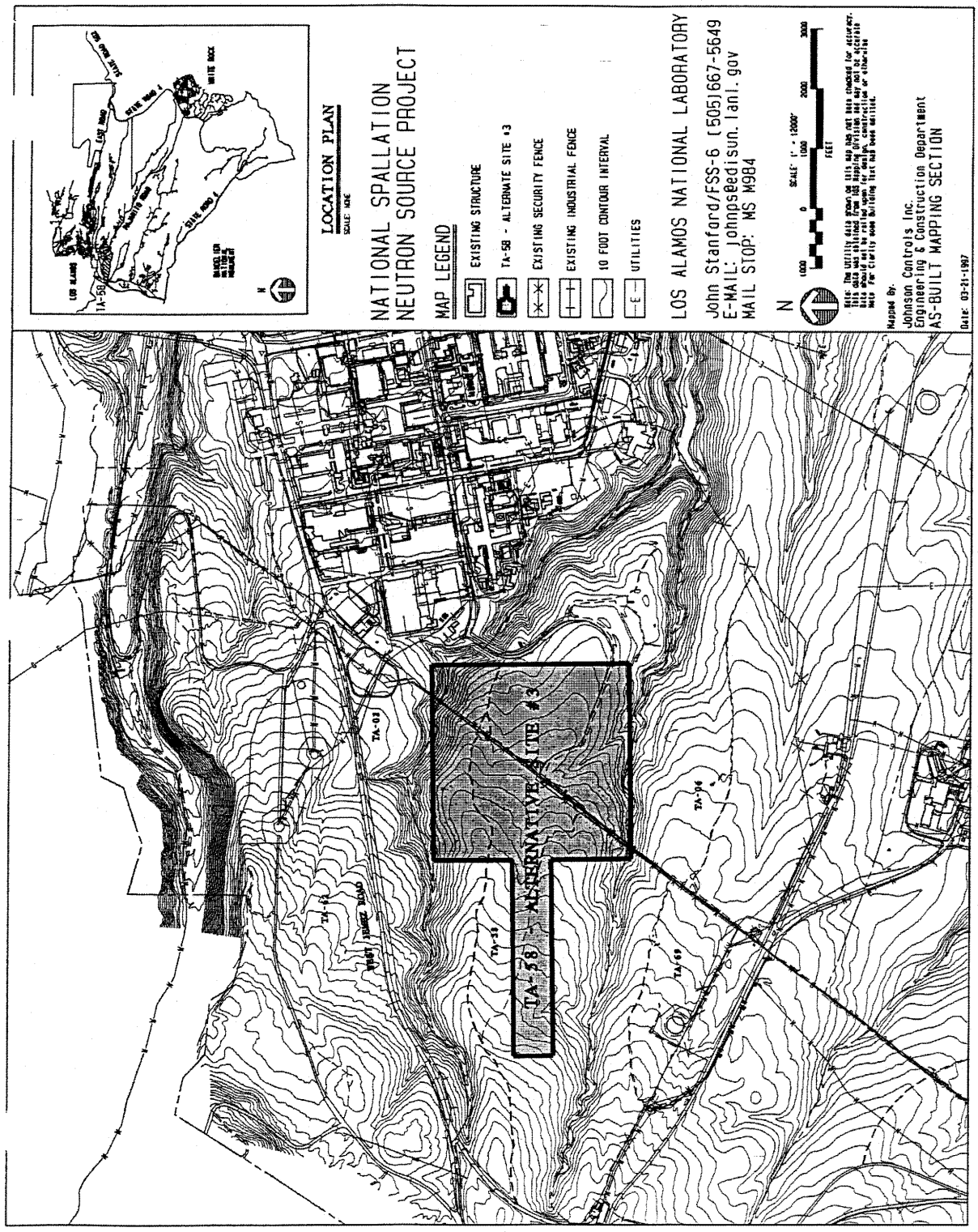
Candidate sites at TAs 70, 33 or 71 could physically accommodate the NSNS facility. None of these three sites is located on the major fault lines shown in the 1990 Site Development Plan for LANL. However, there are similar constraints at each site:

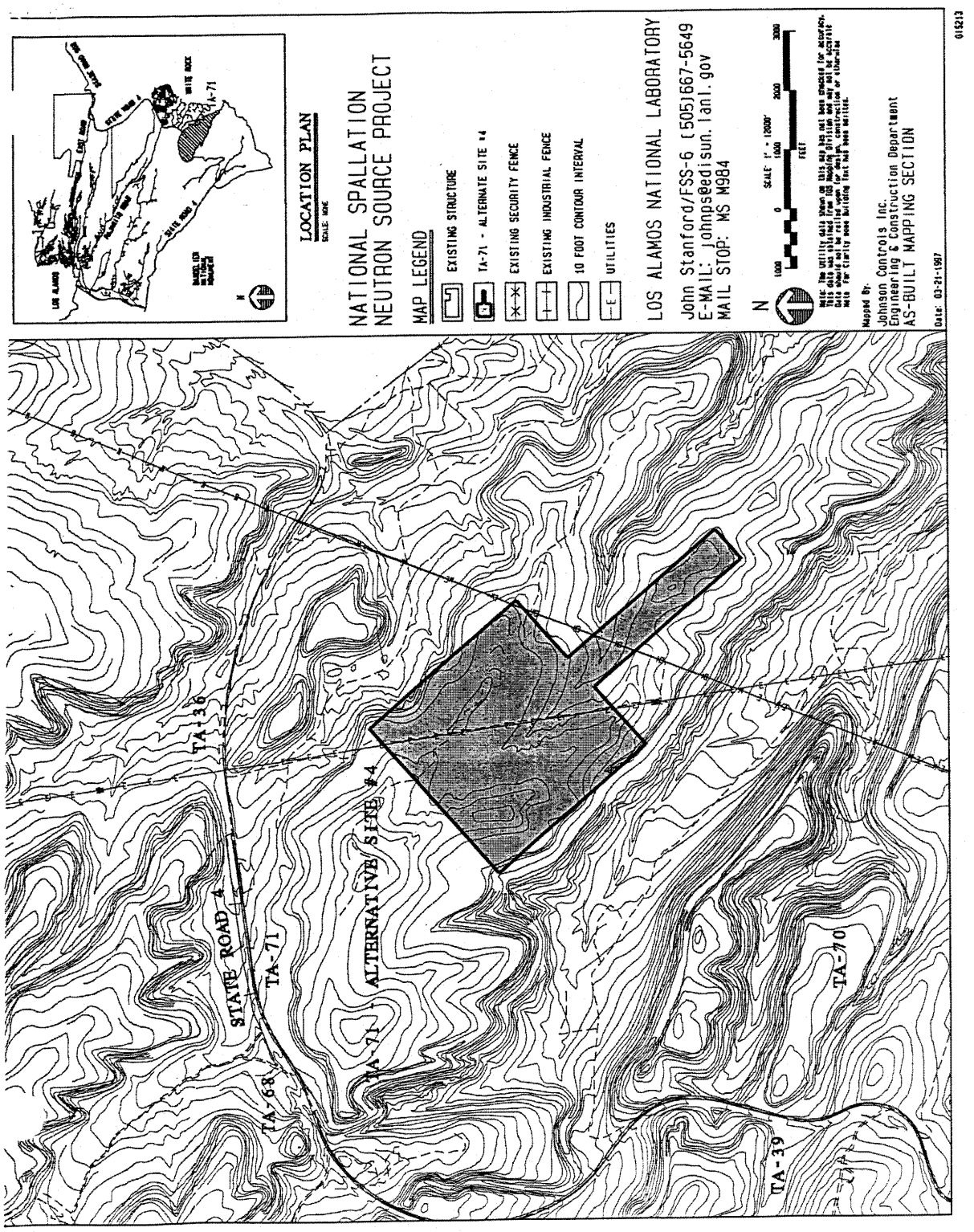
- Construction on sites with grade changes ranging between 110 and 140 feet
- Utility corridors requiring realignment
- Cultural resources are either documented or expected at all alternative sites but mitigation of adverse effects on cultural resources could be achieved through data recovery
- Threatened or endangered species concerns
- Buffer encroachments - particularly at TA-33 (Bandelier National Monument) and TA-71 (the White Rock community)

A comparison of the sites was accomplished by assigning a score to each of the cells in Table 1, weighting each criteria and summing the scores. This analysis showed that TA-70 and TA-71 rank nearly the same and either one could be chosen as the recommended site. However, the fact that TA-70 has an adequate buffer zone and its utility corridor could be more easily realigned gives it a slight advantage over TA-71. Therefore, we recommend that TA-70 (Alternative Site #1) be designated as the LANL candidate site to accommodate the NSNS facility.


LOCATION PLAN
NATIONAL SPALLATION
NEUTRON SOURCE PROJECT
MAP LEGEND
EXISTING STRUCTURE
TA-70 - ALTERNATE SITE #1
EXISTING SECURITY FENCE
EXISTING INDUSTRIAL FENCE
10 FOOT CONTOUR INTERVAL
UTILITIES
LOS ALAMOS NATIONAL LABORATORY
John Stanford/FSS-6 (505)667-5649
E-MAIL: johnps@edisun.lanl.gov
MAIL STOP: MS M984
N
SCALE 1" = 1200'
FEET
Mapped By:
Johnson Controls Inc.
Engineering & Construction Department
AS-BUILT MAPPING SECTION
Date: 03-21-1997
TA-70 - ALTERNATIVE SITE #1
TA-70
STATE ROAD 4
TA-33
TA-33


LOCATION PLAN
NATIONAL SPALLATION
NEUTRON SOURCE PROJECT
MAP LEGEND
EXISTING STRUCTURE
TA-33 - ALTERNATE SITE #2
EXISTING SECURITY FENCE
EXISTING INDUSTRIAL FENCE
10 FOOT CONTOUR INTERVAL
UTILITIES
LOS ALAMOS NATIONAL LABORATORY
John Stanford/FSS-6 (505)667-5649
E-MAIL: johnps@edisun.lanl.gov
MAIL STOP: MS M984
Johnson Controls Inc.
Engineering & Construction Department
AS-BUILT MAPPING SECTION
TA-33 - ALTERNATIVE SITE #2
TA-10
TA-11
TA-33


LOCATION PLAN
SCALE: NONE
NATIONAL SPALLATION
NEUTRON SOURCE PROJECT
MAP LEGEND
EXISTING STRUCTURE
TA-58 - ALTERNATE SITE #3
EXISTING SECURITY FENCE
EXISTING INDUSTRIAL FENCE
10 FOOT CONTOUR INTERVAL
UTILITIES
LOS ALAMOS NATIONAL LABORATORY
John Stanford/FSS-6 (505)667-5649
E-MAIL: johnps@edisun.lanl.gov
MAIL STOP: MS M984
N
SCALE: 1" = 1200'
FEET
Mapped By:
Johnson Controls Inc.
Engineering & Construction Department
AS-BUILT MAPPING SECTION
Date: 03-21-1997
TA-58 - ALTERNATIVE SITE #3
TA-03
TA-64
TA-35
TA-69
TA-54
WEST JEMEZ ROAD


LOCATION PLAN
NATIONAL SPALLATION
NEUTRON SOURCE PROJECT
MAP LEGEND
EXISTING STRUCTURE
TA-21 - ALTERNATE SITE #4
EXISTING SECURITY FENCE
EXISTING INDUSTRIAL FENCE
10 FOOT CONTOUR INTERVAL
UTILITIES
LOS ALAMOS NATIONAL LABORATORY
John Stanford/FSS-6 (505)667-5649
E-MAIL: johnps@edisun.lanl.gov
MAIL STOP: MS M984
Mapped By:
Johnson Controls Inc.
Engineering & Construction Department
AS-BUILT MAPPING SECTION
Date: 03-21-1997
STATE ROAD 4
TA-71
TA-36
TA-68
TA-21
ALTERNATIVE SITE #4
TA-70
TA-39

ARGONNE NATIONAL LABORATORY
SITE SELECTION REPORT

This page intentionally left blank.

Final Report

Selection of a Single Alternative Site at Argonne National Laboratory-East for the National Spallation Neutron Source

Elisabeth Ann Stull, James Kuiper, Robert Van Lonkhuyzen, and Konstance Wescott
Environmental Assessment Division
Argonne National Laboratory

May 1998

Background

This report describes the selection of a single alternative site at Argonne National Laboratory-East (ANL) for the National Spallation Neutron Source (NSNS). The purpose of selecting a site at ANL is to provide an alternative site for analysis in the NSNS EIS, which will be prepared according to the requirements of the National Environmental Policy Act of 1969. DOE has determined that ANL is a reasonable alternative site for this facility. Other alternative sites include the preferred site, Oak Ridge National Laboratory (ORNL) and Los Alamos National Laboratory (LANL).

This siting analysis is based on a draft report, entitled *Draft National Spallation Neutron Source Project Alternative Selection at Argonne National Laboratory-East*, prepared by W. S. White, Chicago Operations Office, on February 27, 1997. That report tentatively identified four potential sites (Figure 1), one each in the 400 Area in the southwestern corner of the site (Alternative 1), the 800 Area in the northwestern corner of the site (Alternative 2), the 600 Area in the central area of the site (Alternative 3), and the East Area (Alternative 4). These sites were selected by overlaying a representative 110-acre quadrant onto an Argonne National Laboratory-East site map. At the time that report was written, area was the only siting criteria available. Current requirements for site area are greater in extent than were used in the February 27, 1997 report, the site configuration is now known, and general siting criteria have been established. This siting report reflects the changes in site area requirements, site configuration, and siting requirements.

This siting analysis is based on certain assumptions about the description of the project. These assumptions were used at the request of the NSNS NEPA Document Manager in order to ensure that the ANL site analysis would be consistent with the alternatives at ORNL and LANL. It should be noted that certain organizations within ANL have proposed that an NSNS at ANL would be of a different configuration than that proposed for ORNL and should be located at a site not selected in this report based on the EIS siting assumptions. The EIS assumptions are:

- That the area of land required for the facility would be the same as used for siting at ORNL and Los Alamos National Laboratory. There would be no adaptation for preconceptual designs earlier proposed by ANL.

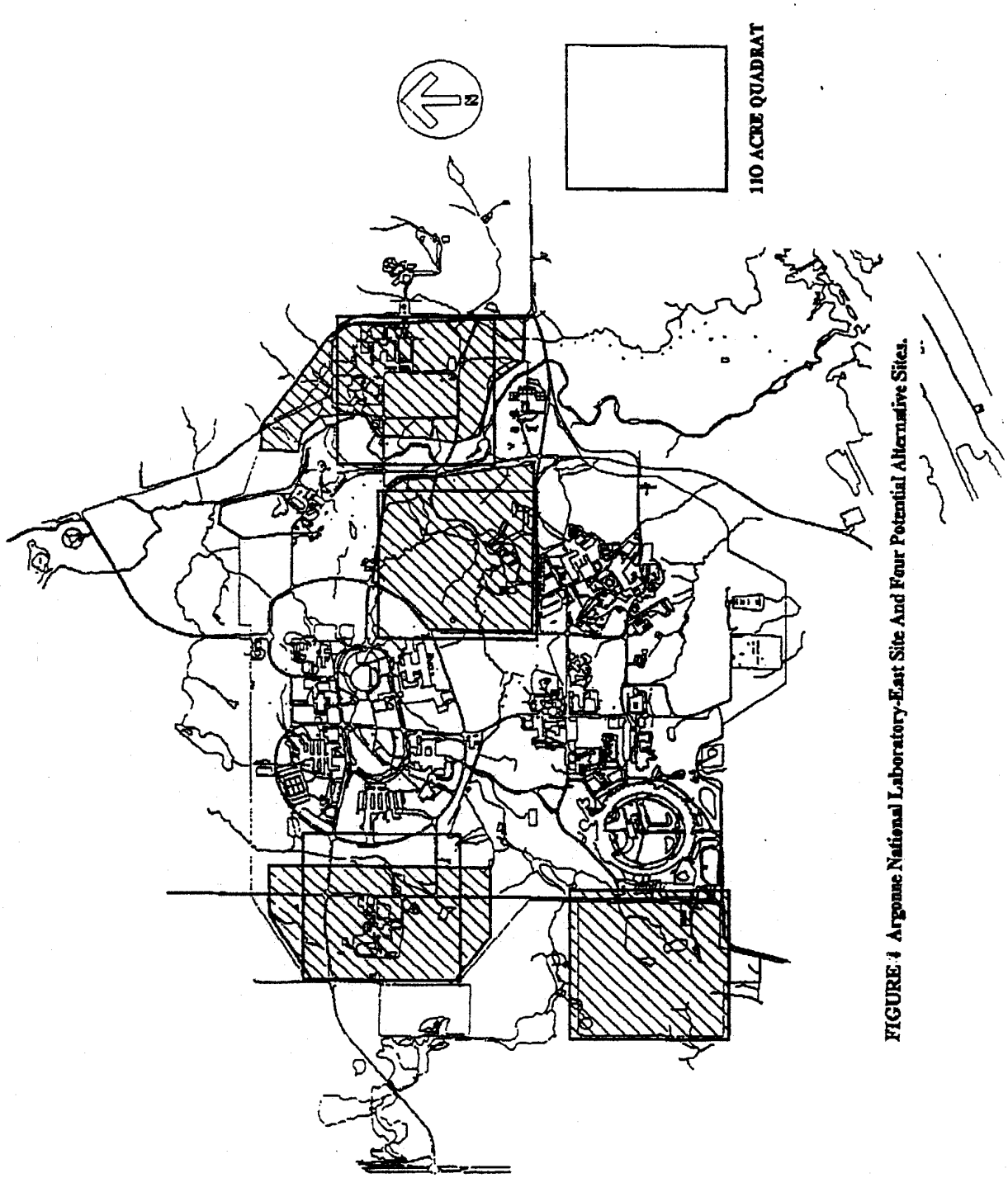


FIGURE 4 Argonne National Laboratory-East Site And Four Potential Alternative Sites.

- That the configuration and shape of the site would be the same at ANL as at ORNL or LANL. There would be no adaptation to ANL conditions or adaptations for preconceptual designs optimized for ANL site conditions.
- That the NSNS accelerator and support facilities would be of the same design assumed for ORNL or LANL; there would be no adaptation or optimization for conditions and existing facilities at ANL.
- That the same siting criteria developed for conditions at ORNL would be used for the ANL siting analysis, although several of these may not have much bearing on the development constraints present in the glacial till area in which ANL is located.

Siting Criteria

Since the initial DOE siting report was prepared for ANL, further siting criteria for the NSNS have been specified, including 1) functional criteria, based on construction and operational requirements of the facility; 2) environmental criteria, 3) criteria related to health and safety, and 4) programmatic criteria. These criteria have been developed for selecting a NSNS site at ORNL; and they have been applied for selection of an alternative site at LANL. The criteria are:

1. Functional Criteria

    - The main building site has a requirement of 500 m x 500 m with an adjoining 100 m x 500 m centered on the main area (T- or hammer-shaped); all on the same elevation after excavation and founded on bedrock. An adjacent area, measuring 100,000 m^2, is needed for support facilities, roads, buffer, etc., which can be on different elevations.
    - The main buildings must be constructed on solid rock foundation; however, karst formations are not to be eliminated as candidate sites.
    - Sufficient earth backfill must be available on site or nearby to provide an average of 15 ft cover for the main building.
    - The site must be in reasonable proximity to a disposal area for rock and excess earth excavation, such as a previously expended borrow area.
    - The site location minimizes excavation of contaminated soils.
    - The site should avoid the cost of relocating significant overhead and underground utilities (e.g. power lines, water line mains, and gas transmission lines).
    - The location should minimize runoff to or through the site.
    - The site should be in close proximity and access to existing utility systems, including 30-40 MW of electrical power. Other utility requirements include potable water, compressed air, natural gas, sanitary sewer, steam and chilled water (can be provided by onsite facilities), and construction power within one mile.
    - The site should be in close proximity to primary and/or secondary roads.

2. Environmental Criteria

- The site should avoid disturbance of wetlands and streams.
- The site should avoid locations with threatened or endangered plant or animal species.
- The site should avoid locations with historic, cultural, or archeological resources.
- The site should minimize impact on natural, reference, and research areas, including NERPs[1].

2. Health and Safety Criteria

- The site must be located above the 500-year floodplain elevation.
- The site must avoid geological faults prone to seismic movement.
- The site must provide a minimum 500 meter separation from existing occupied structures.

3. Programmatic Criteria:

- The site should consider appropriate site development and land use plans.

Method of Analysis

The characteristics of the four sites with respect to the siting criteria were determined by examining existing data sets contained in the ANL Sitewide Geographic Information System. The footprint of the proposed facility was overlaid on each of the four areas identified in the earlier siting report, and the footprints were rotated and moved so at to achieve the best possible fit with the siting criteria in or near each of the four areas (Figure 2). Because the footprint of the facility has a maximum dimension of 1000 meters, which is greater than the dimensions (691 m) of the 110-acre areas originally identified in the first siting report, none of the footprints fit exactly within the boundaries identified in the earlier report.

Each of the four sites were evaluated against each siting criterion, and a subjective opinion developed as to whether 1) the site easily met or exceeded the criterion [+], 2) could meet the criterion with a small degree of mitigation or site conditions were only mildly unfavorable [O], or 3) the site clearly failed the criterion or site conditions were clearly unfavorable [-]

Results

The results of the evaluation of potential sites against the siting criteria are presented in Table 1. On the basis of this evaluation, Alternative 1 (400 Area) met or exceeded five of the criteria and clearly failed ten, Alternative 2 (800 Area) met or exceeded seven of the

[1] National Environmental Research Parks (NERPs) are areas of DOE sites designated for environmental and ecological research.

criteria and clearly failed five, Alternative 3 (600 Area) met or exceeded six of the criteria and clearly failed eight, and Alternative 4 (East Area) met or exceeded six of the criteria and clearly failed eight.

All sites meet several of the siting criteria.

1. All sites have the necessary area available to accommodate the site footprint.
2. None of the locations are over known faults.
3. All areas are near or are crossed by paved roads.
4. Research and development use is consistent with the Site Development Plan.

All sites also do not meet several of the siting criteria.

1. At all sites the depth to bedrock is greater than 60 ft. It is assumed that an NSNS at ANL would not be founded on bedrock. Even so, construction and operation of accelerator facilities has been highly successful at ANL.
2. ANL does not have an onsite source of backfill; material from excavation would have to be used, unless fill were brought in from offsite.
3. ANL does not have an onsite disposal area for large volumes of excavated material; offsite disposal would be necessary
4. All sites contain wetland areas or streams.
5. All areas have historic, cultural, or archeological resources; one with an site that eligible for listing and the others with areas for which eligibility needs to be determined.
6. All locations are closer than 500 m to the nearest occupied structure.

Alternative 2 in the 800 Area at the northwest corner of ANL comes the closest to meeting the siting criteria (Table 1), and was determined to be the best siting location at ANL. The advantages of this location are: 1) differences in surface elevation are moderate (30 ft), 2) no state or federal threatened or endangered species are known to use the site, and 3) the area has little ecological research potential. Limited utilities are onsite, but are located nearby. Other disadvantages of the location include: 1) four contaminated areas which are currently under consideration for remediation, 2) an unused water pumping station and associated water mains might have to be removed, and 3) presence of a small drainage way on site.

As with all the other sites, fill for the 800 Area site would be obtained off the ANL site and rock and excess earth would be disposed of off the ANL site. One of the archeological sites would need a determination whether it is eligible for listing under the National Historic Preservation Act. The site is very close to other occupied structures; a guard house at 20 meters and an office/laboratory building at 110 meters. This site has one disadvantage which is not related to a site selection criteria; it overlays and blocks the Westgate Rd. entrance to the site. Westgate road and the entrance guard house would have to be relocated around the periphery of the facility.

Alternative 4 in the East Area was determined to be the second best location. The advantages of this location are: 1) differences in elevation are moderate (30 ft), 2) no known state of federal threatened or endangered species are known to use the site, and 3) the area has little ecological research potential. The disadvantages of this location are: 1) the foot print overlays the main gas line to the ANL site, possibly requiring removal and relocation; 2) the linac portion of the footprint would cross Sawmill Creek, a permanent stream, and the associated 100-yr and 500-yr floodplain and bordering wetlands. Other disadvantageous characteristics include: 1) four contaminated areas which are currently under consideration for remediation, and 2) partial utility availability onsite with others located nearby. Alternative 4 would be located in an area which houses storage areas, plant facilities services buildings, and shipping and receiving. Relocation of these facilities might be necessary.

Alternative 3 in the 600 Area is the third best of the alternatives. The advantages of this location include: 1) no known state of federal threatened or endangered species are known to use the site, and 2) the area has little ecological research potential. The disadvantages of this location are: 1) the foot print overlays the main steam and gas lines to the ANL site, possibly requiring removal and relocation; 2) the linac portion of the footprint would cross Freund Brook, a permanent stream, and the associated 100-yr and 500-yr floodplain and bordering wetlands, and 3) a pond on Freund Brook and associated wetlands are within the main portion of the footprint. Other disadvantageous characteristics include: 1) greater differences in elevation than the other sites (60 ft), 2) one known area of contamination which is under consideration for remediation, and 3) partial availability of utilities onsite with others located nearby. Construction of the NSNS at Alternative 3 might require removing the original Freund Lodge (which predates ANL), a motel-like facility, several cottages, the swimming pool, and the tennis courts. The lodging function of these facilities could be taken over by ANL's new hotel-like lodging facility near the Advanced Photon Source.

Alternative 1 in the 400 Area was judged to be the least favorable site. Advantageous characteristics include: 1) differences in surface elevation are moderate (30 ft) and 2) there are no identified areas of site contamination. Disadvantages of this location include: 1) the only possible orientation for the footprint overlays an interstate gas transmission line; 2) utility service to the site is very limited, although utilities are nearby, 3) state-listed birds, reptiles, and plants are present, 4) the site contains a remnant prairie, old oak woodlands, ponds and wetlands with good research potential, 5) and the site contains headwater ephemeral ponds and wetlands and the 500-yr and 100-yr floodplains of Upper Freund Brook.

One difficulty with this site is that the footprint alignment can not be reoriented to avoid the gas transmission line without either a land exchange to modify the boundaries of ANL or moving the facility further into Upper Freund Brook and associated wetlands. If some rounding of the corners of the site were allowed, the gas transmission line might be avoided. The site is very close to another accelerator facility, the Advanced Neutron Source, which constrains site rotation in the clockwise direction. If the site were rotated in the counter-clockwise direction, main area and the linac of the NSNS would further encroach on the floodplain and wetlands associated with Upper Freund Brook. These drainage features include the headwaters of Upper Freund Brook and a series of small ponds and marshes. State endangered species known from this location include the Black-crowned Night Heron (feeding habitat), the Great Egret (feeding habitat), Kirkland's Water Snake (resident), and a state-listed marsh plant. This site also contains eight archeological sites. A site near the tip of the linac is eligible for listing. Several of the other sites would need a determination whether they are eligible for listing. One corner of the site is within

an area that is thought to be a prairie remnant, a habitat-type with significant regional cumulative impacts and potential value for research purposes.

Conclusion

The alternative location which most closely matches the siting criteria for the NSNS is Alternative 2 in the 800 Area at the northwest corner of the ANL site. This location has the least involvement with floodplains, wetlands, threatened and endangered species, research areas, important habitats, and unfavorable topography. This site has several disadvantages related to several small areas of contamination and proximity to occupied structures. In addition, the site overlays Westgate Road, the west entrance to ANL. Without further engineering design information for NSNS, it is uncertain whether the alignment of the footprint could be moved south enough to reroute Westgate Road around the perimeter of the facility. Moving the facility to the south would place the linac portion of the footprint near on Upper Freund Brook and impinge on wetlands and floodplains in that area.

Table 1. Evaluation of the Potential Sites for the National Spallation Neutron Source.

(+ = favorable or meets or exceeds criterion; 0 = could meet criterion with minor mitigation or mildly unfavorable; - = clearly fails the criterion or conditions clearly unfavorable)

Siting Criteria	Alt. 1: 400 Area Suitability	Alt. 2: 800 Area Suitability	Alt. 3: 600 Area Suitability	Alt. 4: East Area Suitability
FUNCTIONAL CRITERIA				
Main building site requirement of 500 m x 500 m with an adjoining 100 m x 500 m centered on the main area (T- or hammer-shaped); all on the same elevation after excavation and founded on bedrock. An adjacent area measuring 100,000 m2 for support facility	Area available. Surface elevation differences of about 30 ft. (see below for geology) +	Area available. Surface elevation differences of about 30 ft. (see below for geology) +	Area available. Surface elevation differences of about 60 ft. (see below for geology) 0	Area available. Surface elevation differences of about 30 ft. (see below for geology) +
Main buildings must be constructed on solid rock foundation; however karst formations are not to be eliminated as candidate sites.	110-120 ft of material above bedrock. -	110-130 ft of material above bedrock. -	80-170 ft of material above bedrock. -	60-70 ft of material above bedrock. -
Sufficient earth backfill available on site or nearby to provide an average of 15 ft cover for the main building.	Material from excavation of site available for backfill, no other onsite source. 0	Material from excavation of site available for backfill, no other onsite source. 0	Material from excavation of site available for backfill, no other onsite source. 0	Material from excavation of site available for backfill, no other onsite source. 0
Reasonable proximity to disposal area for rock and excess earth excavation, such as previously expended borrow area.	No onsite disposal area. -	No onsite disposal area. -	No onsite disposal area. -	No onsite disposal area. -
Site minimizes excavation of contaminated soils.	no identified areas of contamination +	4 known areas of contamination 0	1 known area of contamination 0	4 known areas of contamination 0

Siting Criteria	Alt. 1: 400 Area Suitability	Alt. 2: 800 Area Suitability	Alt. 3: 600 Area Suitability	Alt. 4: East Area Suitability
Should avoid cost of relocating significant overhead and underground utilities (e.g. power lines, water line mains, and gas transmission lines).	Footprint overlays an interstate gas transmission line at the southern boundary of the ANL site, footprint placement constrained by wetlands. −	Buildings in area needing utilities have been demolished or are slated for demolition. Water pumping station and associated water mains are not in use. +	Footprint overlays main steam line and gas line to the interior of ANL. −	Footprint overlays main gas line to the ANL site. −
Minimize runoff to or through the site.	Some short-term runoff during storm events. Ponding in headwater wetlands to Upper Freund Brook. −	Some short-term runoff during storm events. 0	Major receiving stream for stormwater runoff. −	Major receiving stream and floodway for stormwater runoff. −
Close proximity and access to existing utility systems, including 30-40 MW of electrical power. Other utility requirements include: potable water, compressed air natural gas, sanitary sewer, steam and chilled water, and construction power.	Limited utilities on site, utilities available nearby. 0	Limited utilities on site, utilities available nearby. 0	Good utility service adjacent to site. +	Partial utility availability onsite. 0
Close proximity to primary and/or secondary roads.	Road access to area. +	Road access to area. +	Road access to area. +	Road access to area. +

Siting Criteria	Alt. 1: 400 Area Suitability		Alt. 2: 800 Area Suitability		Alt. 3: 600 Area Suitability		Alt. 4: East Area Suitability	
ENVIRONMENTAL CRITERIA								
Avoid disturbance of wetlands and streams	Small ponds and marshes on site, main area and linac contains the headwaters of Upper Freund Brook and its associated wetlands.	-	Main area contains a small drainage way with wetland vegetation and a remnants an abandoned beaver pond. Tip of linac reaches border of wetlands on Upper Freund Brook.	-	Main area and linac contains Freund Brook and a pond and associated wetlands.	-	Main area and linac contains Sawmill Creek and associated wetlands.	-
Avoid locations with threatened or endangered plant or animal species	State listed birds, reptiles, and plants.	-	No Involvement	+	No Involvement.	+	No Involvement.	+
Avoid locations with historic, cultural, or archeological resources present	Eight known sites, one eligible site at the tip of the linac, several sites need to have eligibility determined.	-	Two sites, one not eligible, one site needs eligibility determined.	-	One large area needs to have eligibility determined.	-	One large area needs to have eligibility determined.	-
Minimize impact on natural, reference, and research areas, including NERPs.	Remnant prairie present, old oak woodlands, ponds and wetlands with best research potential.	-	Small amount of old oak. Little research potential.	+	Some areas of woodland. Research potential low.	+	Research potential low.	+
HEALTH AND SAFETY CRITERIA								
The site must be located above the 500-year floodplain elevation.	Site contains 500 year floodplains, and is in the 100-year floodplain of Upper Freund Brook.	-	Site avoids 500-year floodplains, except for small drainage way at the north east edge of the site.	O	Linac portion of the footprint crosses Freund Brook and its 500-year and 100-year floodplains.	-	Linac portion of the footprint crosses Sawmill Creek and its 500-year and 100-year floodplains.	-

Siting Criteria	Alt. 1: 400 Area Suitability	Alt. 2: 800 Area Suitability	Alt. 3: 600 Area Suitability	Alt. 4: East Area Suitability
The site must avoid geological faults prone to seismic movement.	No known faults. +	No known faults. +	No known faults. +	No known faults. +
The site must provide a minimum 500 meter separation from existing occupied structures.	Nearest occupied buildings are 65 m. -	Nearest occupied buildings are 110 m. Guard post at site entrance is within 20 m, but would be moved. -	Nearest occupied buildings are 160 m. -	Nearest occupied buildings are130 m. -
PROGRAMMATIC CRITERIA				
Site considers appropriate site development and land use plans.	Research and development use consistent with Site Development Plan +	Research and development use consistent with Site Development Plan +	Research and development use consistent with Site Development Plan +	Research and development use consistent with Site Development Plan +
Total Suitability	5 + 2 O 10 -	7 + 5 O 5 -	6 + 3 O 8 -	6 + 3 O 8 -

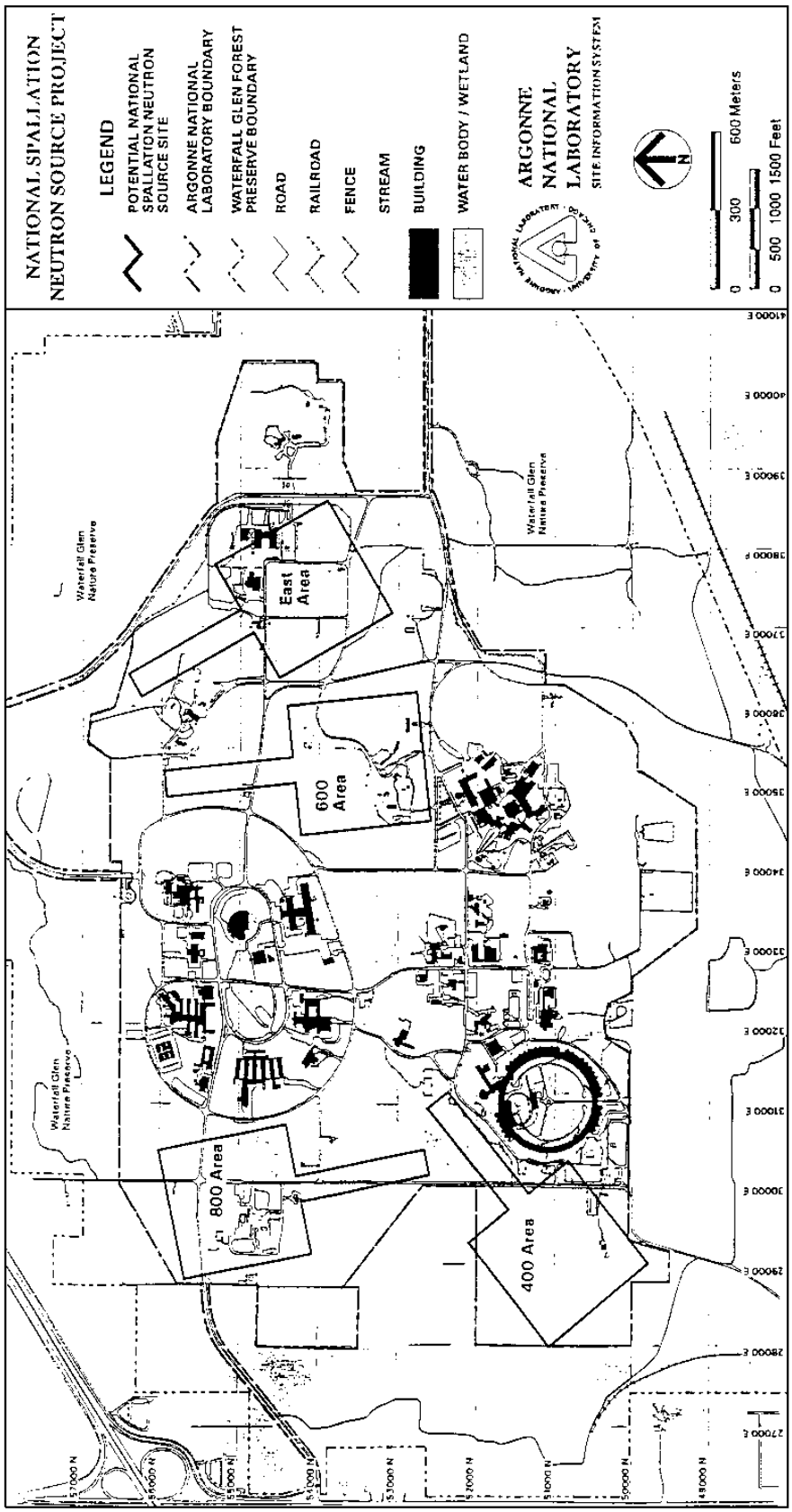


Figure 2. Argonne National Laboratory-East Site and Four Potential Alternative Sites

BROOKHAVEN NATIONAL LABORATORY
SITE SELECTION REPORT

This page intentionally left blank.

NATIONAL SPALLATION NEUTRON SOURCE
BNL SITE SELECTION REPORT

Brookhaven National Laboratory
September 16, 1997

INTRODUCTION

This report evaluates four potential sites for construction of the National Spallation Neutron Source (NSNS) at Brookhaven National Laboratory (BNL) in Upton, New York. In 1995 the Department of Energy (DOE) determined that NSNS would require an Environmental Impact Statement (EIS). The DOE then developed a process to identify suitable alternatives to the DOE's "preferred alternative" at Oak Ridge National Laboratory (ORNL). The process evaluated 39 DOE sites, and BNL qualified as one of three alternative locations besides ORNL for the facility. The other two alternative locations were Argonne National Laboratory and Los Alamos National Laboratory. *(Draft National Spallation Neutron Source Project, Alternate Site Selection Report: U.S. Department of Energy, Office of Energy Research; prepared by Roy F. Weston, Inc., August 23, 1996)*

This report provides the NSNS program with a decision-making tool for selecting an alternative candidate site at Brookhaven National Laboratory for the NSNS facility. The site evaluation process uses the following steps for selecting a recommended site:

- List NSNS physical design parameters provided by the NSNS design team
- Inventory of candidate BNL sites
- Evaluation of each candidate site according to NSNS siting criteria
- Determination of the candidate site with the best attributes and least restrictions to accommodate the NSNS

Four candidate sites were identified from which the recommended site was determined to best meet the NSNS criteria. These areas and the project footprint are illustrated on the four maps presented at the end of this report.

NSNS SITE REQUIREMENTS

The NSNS site must accommodate several physical and environmental requirements. These requirements are categorized as functional, environmental, and programmatic and are listed below.

Functional

- A site that accommodates a hammer-head shaped structure measuring 500 x 500 meters with a tail centered on the above square and measuring 100 x 500 meters
- A site that can be cut to provide proper fill for shielding of hammer-head shaped area.
- Additional space for support buildings and access roads requiring an additional 100,000 square meters
- Reasonable proximity to other facilities at BNL
- Avoid significant overhead and underground utility relocation (e.g., power lines, water line mains and gas transmission lines, steam lines)
- Minimize runoff to, through and from the site
- Reasonable access to existing utility systems to include:
  - 40 MW electrical power
  - potable water
  - compressed air, natural gas, sanitary sewer, steam and chilled water (desirable, can be provided by on-site facilities) availability of construction power within one mile
- Reasonable proximity to primary and/or secondary paved roads for users, researchers, materials, supplies; for target transport; for waste and irradiated material removal
- Buffer zone to avoid residential areas and large worker populations

Environmental

- Avoid construction in or disturbance of wetlands
- Avoid locations with threatened or endangered plant or animal species

Programmatic

- Conform with appropriate site development and land use plans
- Avoid existing recreation uses

INVENTORY OF CANDIDATE BNL SITES

Siting and construction of the NSNS facility is a major undertaking requiring a large site. While BNL covers 10 square miles, a significant portion of the undeveloped area is the head water region of the Peconic River. The four sites are presently undeveloped, and located adjacent to developed areas, and sized to accommodate the NSNS facility. In general terms, the four sites are Central, Northern, North Eastern, and Southern.

Siting Criteria	Central Site	Northern Site	North-Eastern Site	Southern Site
Functional				
1. Physical accommodation of building footprint (500m x 500m with attached 100m x 500m addition)	Adequate	Adequate	Adequate	Adequate
2. Adequate earth backfill to provide an average of 15 feet of cover for shielding	Adequate	Fill will be trucked in from on site	Fill will be trucked in from on site	Adequate
3. Close proximity to BNL support facilities and services	Adjacent to existing facilities / services	Remote from existing facilities / services	Remote from existing facilities / services	Remote from existing facilities / services
4. Avoid relocating significant overhead/ underground utilities	No major utilities in area	No utilities in area	No major utilities in area	No major utilities in area
5. Minimize runoff to, through, and from the site	Acceptable	Located near the head waters of the Peconic River	Located near the head waters of the Peconic River	Acceptable
6. Proximity/ access to existing utility systems (40MW power, potable water, compressed air, natural gas, sanitary sewer, steam, chilled water, construction power	All utilities are local except chilled water & natural gas	Only sanitary is local	Only sanitary is local	No utilities are local
7. Proximity to primary and/or secondary roads	Adequate	Roads will have to be installed	Roads will have to be installed	Adequate
8. Adequate buffer zone	Adequate	Close proximity to residential area	Close proximity to residential area	Close proximity to major public highway
ENVIRONMENTAL				
9. Avoid construction in wetlands	No adverse impact to wetlands	Possible impact to wetlands	Possible impact to wetlands	No adverse impact to wetlands
10. Avoid locations with threatened or endangered plant or animal species	No impact	No impact	No impact	Salamander
PROGRAMMATIC				
11. Compatible with site development and land use plans	Consistent with 1994 Site Development Plan	Encroaches into future RHIC experimental area	Encroaches into future RHIC experimental area	Encroaches into future linear accelerator area
12. Avoid existing recreation uses	Impacts shot gun range	None	None	None

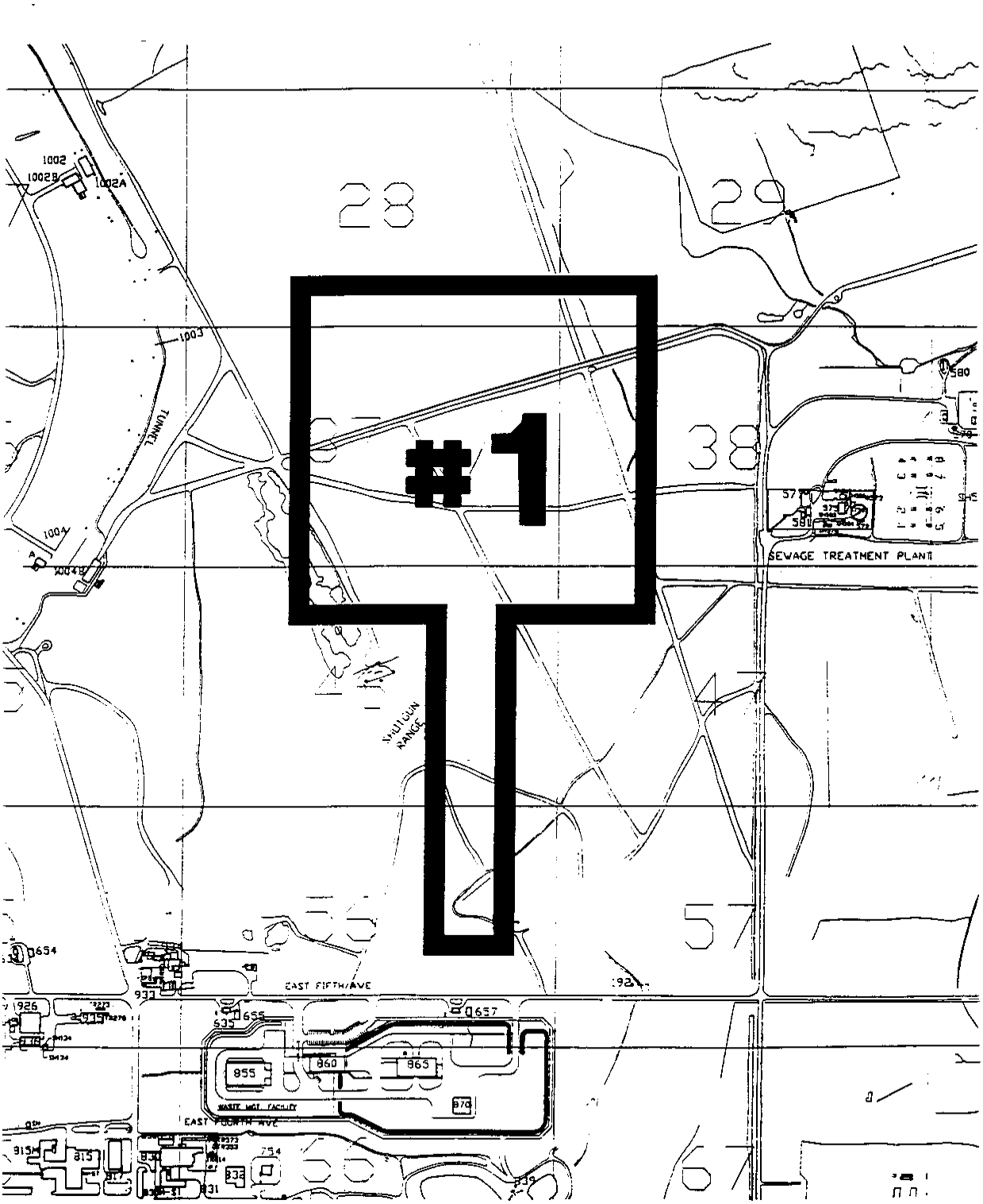
EVALUATION OF CANDIDATE SITES

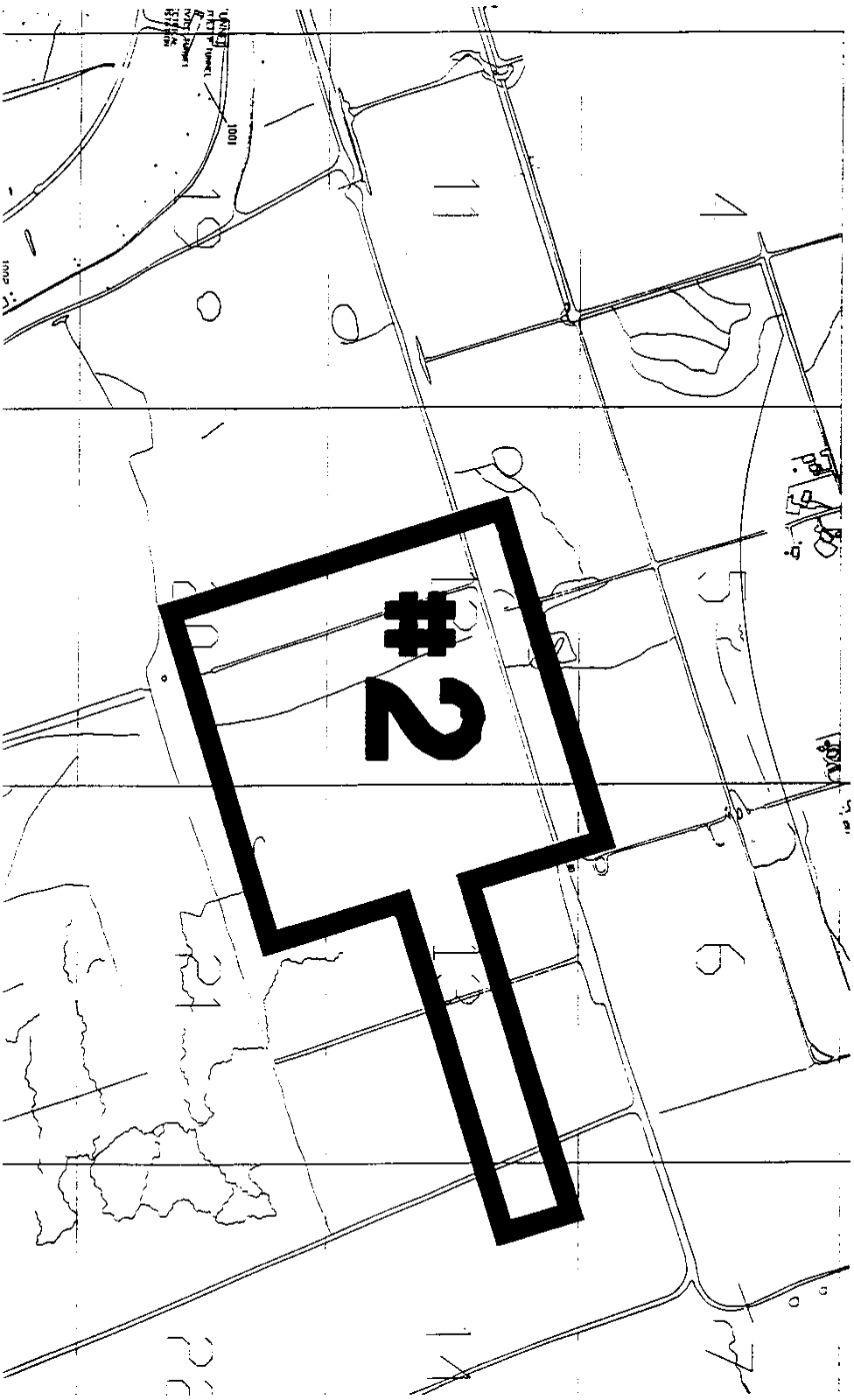
The Central Site has the appropriate gross acreage, topography, proximity to the research community, utility support with the exception of a supply of chilled water and natural gas, roadways, and buffer zone. The site does not impact environmental concerns and can be accommodated into the site development plan.

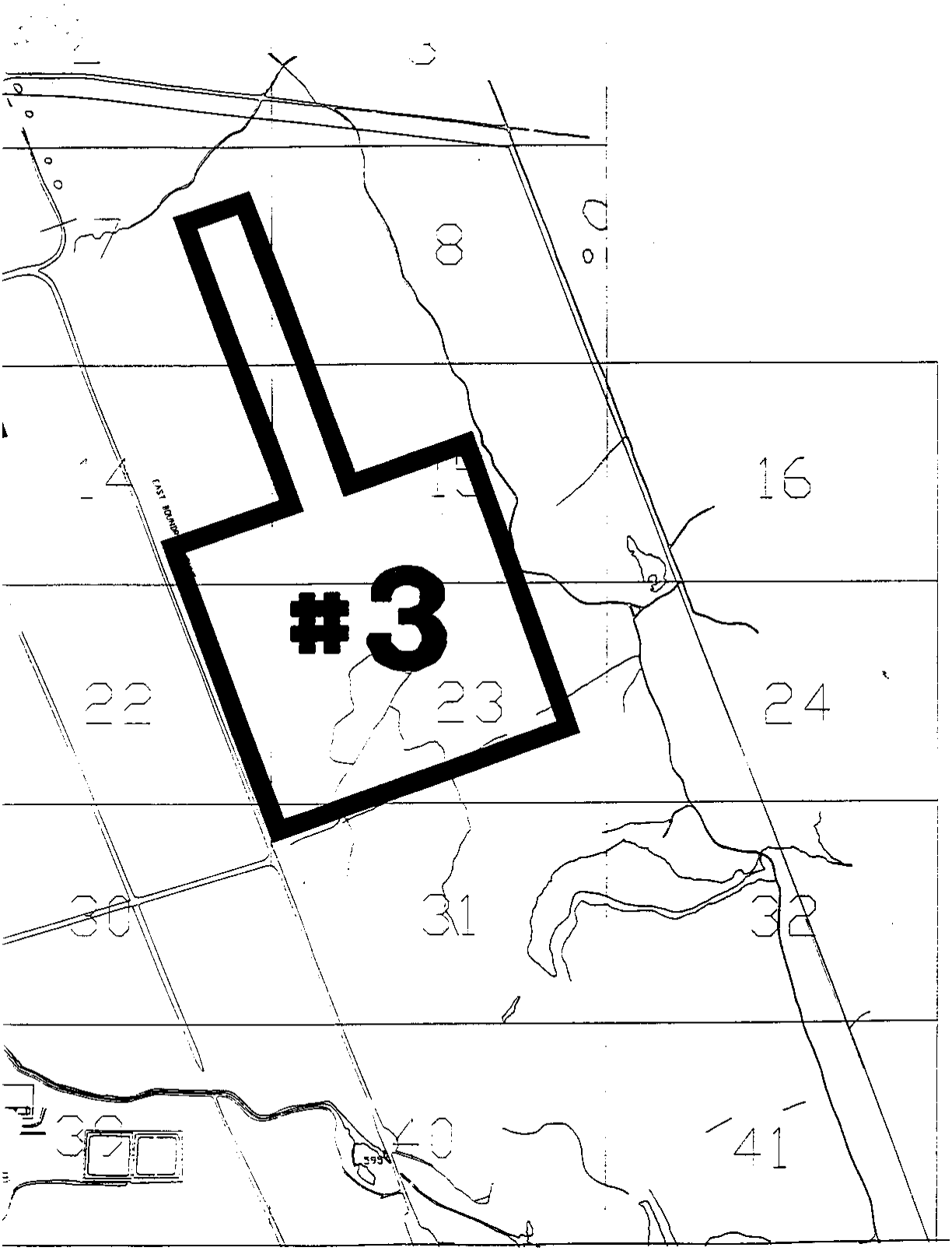
The Northern Site has the appropriate gross acreage. However, the topography requires fill to be truck to the site for the necessary shielding. The site requires new roads and utilities to be constructed into the area. The site is near the head waters of the Peconic River and encroaches into future RHIC experimental areas.

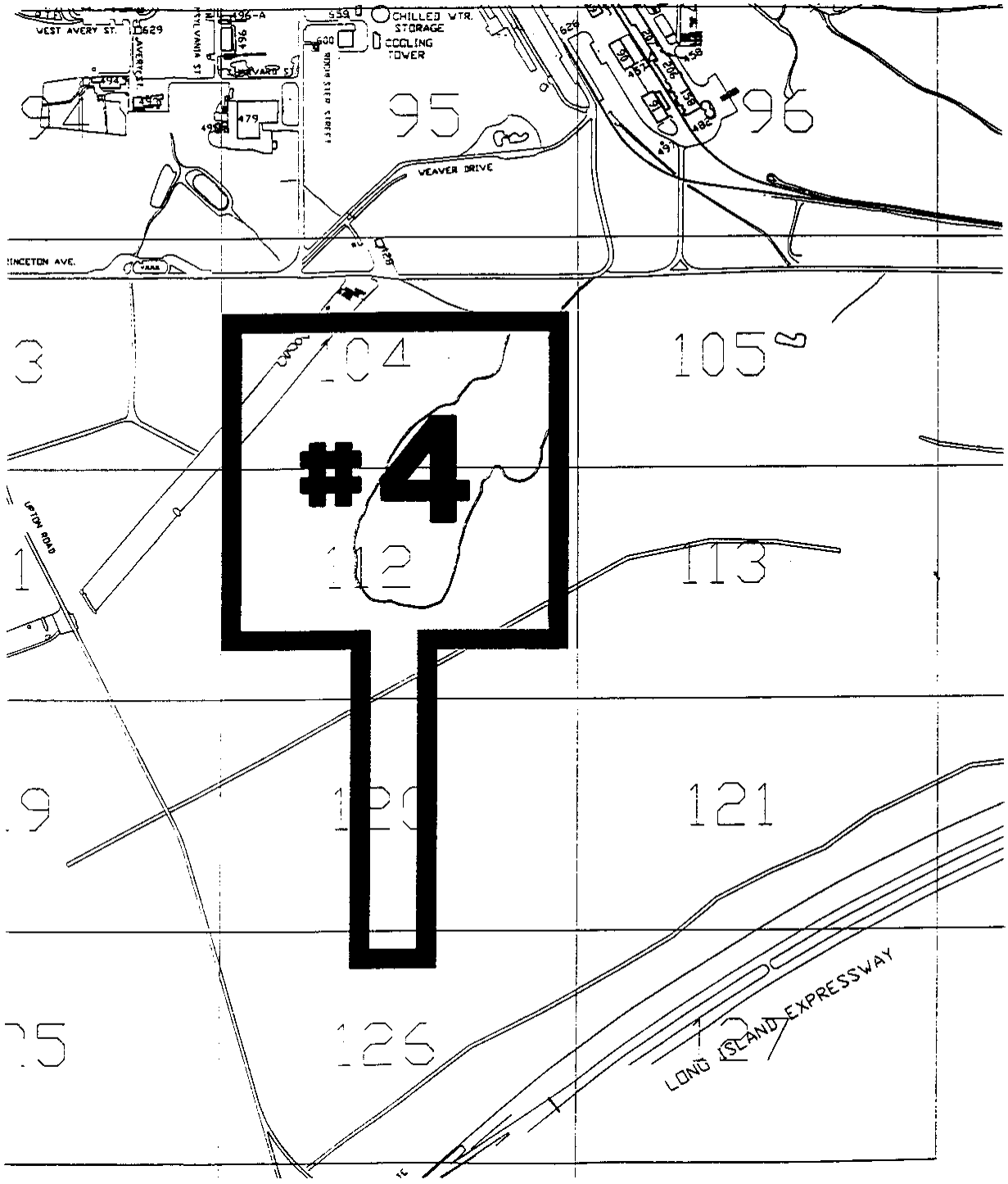
The North-Eastern Site has the appropriate gross acreage. However, the topography requires fill to be truck to the site for the necessary shielding. The site requires new roads and utilities to be constructed into the area. The site is near the head waters of the Peconic River and encroaches into future RHIC experimental areas.

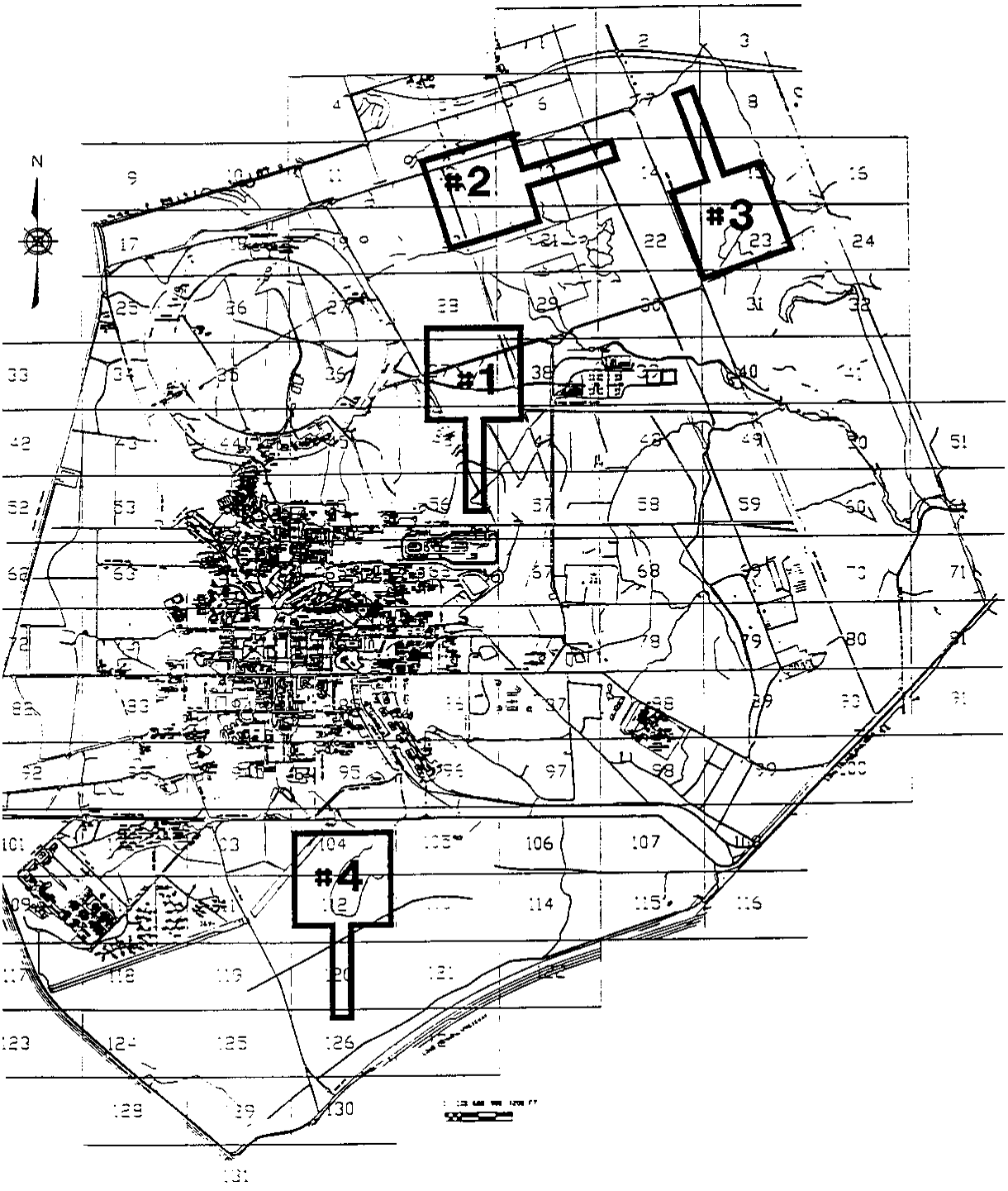
The Southern Site has the appropriate gross acreage, topography and access by major roads. The site requires utilities to be constructed into the area. The site encroaches into future Linear Accelerator Project.


#1
28
29
38
57
1002
1002B
1002A
1003
TUNNEL
100A
100B
580
581
SEWAGE TREATMENT PLANT
SHOTGUN RANGE
654
926
933
EAST FIFTH AVE
655
635
657
855
860
865
870
WASTE WAT FACILITY
EAST FOURTH AVE
815
754
831
832


#2


#3
8
16
22
23
24
31
32
41


#4
WEST AVERY ST.
CHILLED WTR. STORAGE
COOLING TOWER
WEAVER DRIVE
95
96
104
105
112
113
121
126
LONG ISLAND EXPRESSWAY


N
#1
#2
#3
#4

This page intentionally left blank.